#106B

IEC PR-7000M IM250A

GENERAL-PURPOSE REFRIGERATED CENTRIFUGE

INSTRUCTION MANUAL

March 1990

MODEL 3497

50/60 HZ
200/220/240 VAC

Digital, Programmable floor model

WARNING

DO NOT ATTEMPT TO OPERATE THIS CENTRIFUGE BEFORE THOROUGHLY READING SECTION THREE, OPERATION

THIS CENTRIFUGE MUST BE SECURELY MOUNTED TO THE FLOOR AS DESCRIBED IN SECTION TWO, INSTALLATION

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SECTION ONE

DESCRIPTION

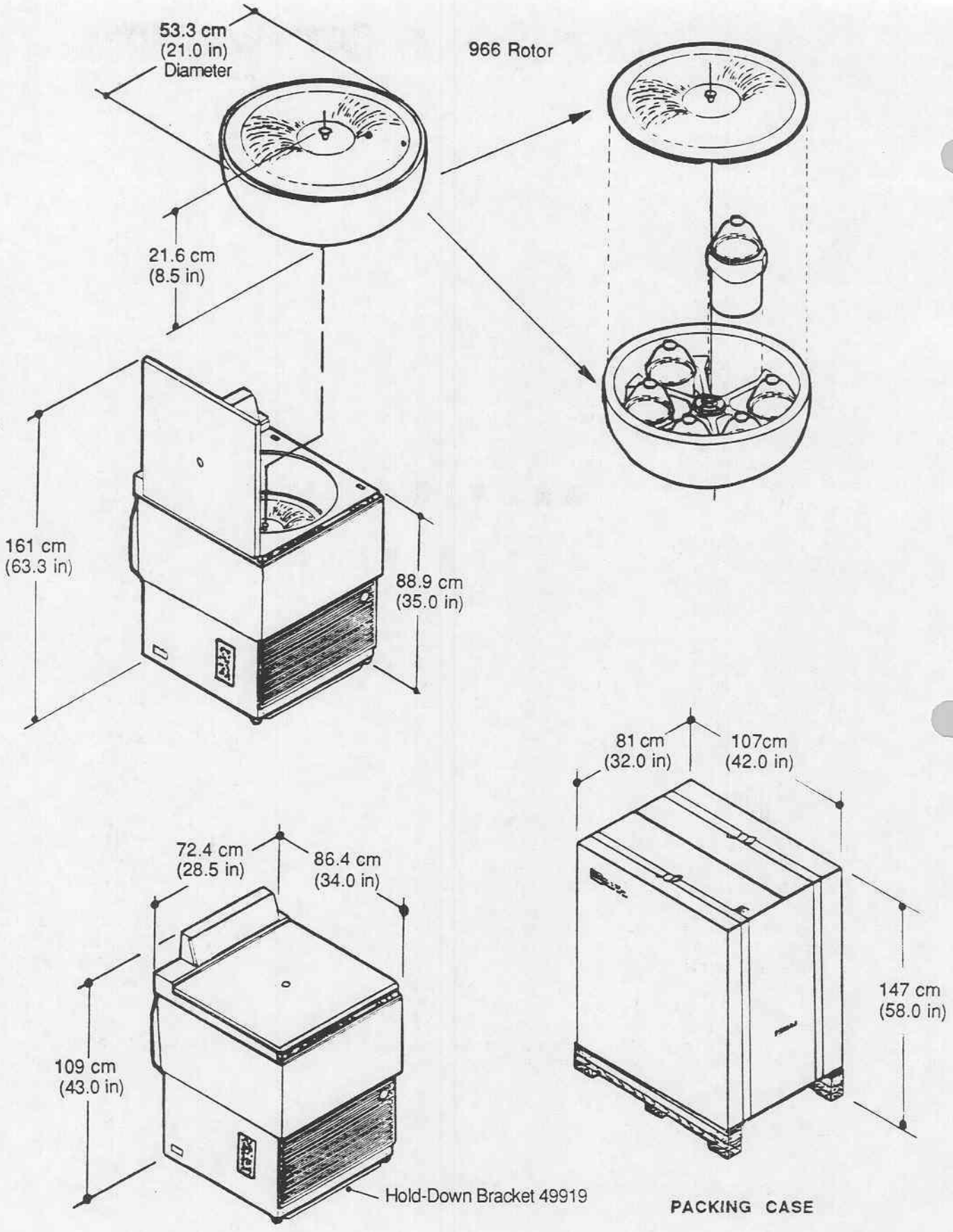


Figure 1-1 Outline Drawing

1.0 GENERAL DESCRIPTION

1.1 Purpose of Manual

This manual provides installing, operating and servicing instructions for the programmable, general purpose, refrigerated, floor Model PR-7000M (Catalog No. 3497) centrifuge manufactured by the International Equipment Company (IEC) and supplied under IEC Parts List 8528.

1.2 Description

The PR-7000M is designed for use in the medical, industrial, and, scientific laboratory to perform separations by centrifugal force. This centrifuge accepts general purpose laboratory rotor and accessory combinations, with capacities of up to one liter bottles. It will develop a maximum relative centrifugal force (RCF) of 9635 x g at a maximum speed of 6900 rpm using the IEC Catalog No. 845A, 45-degree angle rotor. The centrifuge has a maximum volume capacity of six liters using the IEC Catalog No. 949, or the IEC Catalog No. 966, swinging-bucket rotor. Refer to Tables 3-3, 3-4, 3-5 and 3-6 for rotor information. The centrifuge is designed for 200, 220, or 240 VAC, 60 Hz operation. The centrifuge is designed meet the requirements for UL listing and CSA certification.

A base assembly within the steel centrifuge cabinet supports a centrifugation chamber. A stainless-steel walled guard bowl makes up the sides of the chamber. This chamber has a gas-spring counter-balanced cover assembly. The cover assembly contains a transparent window for phototachometer speed-checking purposes, a full-length hinge, a gas spring and two pawls that are part of a latch system which is part of an interlock system. The interlock and the interlock latch are part of the base assembly housing. The interlock prevents operation if the cover is not completely closed and latched. It also prevents the cover from opening when the rotor is turning. An IEC Catalog No. 966 rotor and a rotor-stabilizer kit are supplied. The kit allows the centrifuge to be moved within the existing facility while the 966 rotor is in the rotor chamber.

CAUTION

Never **leave the rotor in the chamber when re-shipping the centrifuge out of the facility otherwise the drive shaft will be damaged and the warranty may be voided.**

Rotor balance discs are supplied for balancing blood-bag cups.

A refrigeration system, contained within the base assembly, provides chamber cooling.

Controls and indicators are located at the front edge of the cabinet and on the control panel, which is mounted on the control housing, above, and to the rear of the chamber.

Front edge controls are used to: apply main electrical power, start and stop the centrifuge and unlatch the cover. Control panel controls are used to: select the program mode, and, to set the chamber-temperature, the run-cycle-acceleration rate, -speed / RCF, -time / $\int w^2 dt$, deceleration rate, -start, and -stop functions of the centrifuge. The acceleration-rate control provides a choice of ten rotor acceleration rate profiles from zero to 250 rpm. At 250 rpm the rotor will accelerate at the maximum rate to the set speed. There are ten deceleration rates shown in a graph in Figure 3-1A.

A choke, an autotransformer, and a motor drive assembly are located on the base assembly. The motor has permanently-sealed self-lubricating ball bearings. The drive-motor top cap and flexible drive shaft project up through the center of the base assembly and into the chamber. The drive assembly motor brushes are accessible from the front of the centrifuge after the front louver is removed.

A power supply printed circuit board (PCB), a relay PCB, a pulse width modulation PCB, a power PCB, two line filters, two electro-mechanical relays, and a full-wave bridge rectifier, are mounted on a power electronic assembly behind a steel panel which forms the rear sloping surface of the cabinet.

A microprocessor logic PC board, and a display PC board, are mounted in the upper rear of the control housing and are accessible after the rear vent plate is removed. The main electrical power cord is located at the rear of the cabinet assembly.

Air vents located on the lower front and the lower rear of the cabinet assembly provide front-to-rear motor and refrigeration component cooling.

The removable front louver and the rear panel and grille allow access to the internal cabinet assembly parts. Most of the electrical parts in the centrifuge have connectors to facilitate servicing or replacement.

The centrifuge base assembly has four swivel casters which provide mobility during installation and relocation. Two leveling feet, mounted at the front of the base assembly, provide centrifuge stability when lowered to the floor. A hold-down bracket is attached to the bottom-front of the centrifuge to secure the centrifuge to the floor before operation.

WARNING

Failure to rigidly secure the centrifuge to a substantial (preferably concrete) floor can, in the event of a rotor disruption, cause hazardous movement of the entire centrifuge.

1.3 Specifications

Table 1-1 provides a quick-reference listing of the specifications.

TABLE 1-1 SPECIFICATIONS

Maximum Relative Centrifugal Force (RCF):	
Angle Rotor (845A)	9635 x g.
Swinging Bucket Rotor (219)	8250 x g.
Maximum Speed of Rotation:	
Angle Rotor (845A)	6900 rpm.
Swinging Bucket Rotor (219)	6200 rpm.
Maximum Volume:	
Swinging Bucket Rotors (949, and 966)	6 liters (6 x 1000 ml).
Angle Rotor (886B)	3 liters (6 x 500 ml).
Maximum Number of Tubes	408 (5 ml tubes.).
Acceleration Rate Control:	
Settings	Ten, From zero to 250 rpm (Max. accel. above 250 rpm).
Type	Digital Key Switch.
Acceleration Rate Indicator:	Digital LED.
Deceleration Rate (Brake) Control:	
Settings	Ten, Refer to Figure 3-1A.
Type	Digital Key Switch.
Deceleration Rate Indicator:	Digital LED.
Speed Control:	
Type	Digital Key Switch.
Increments	100 rpm.
Range	0 to 6900 rpm.
Accuracy (Steady State)	± 10 rpm.
Speed Indicator:	
Type	Digital LED.
Increments	10 rpm (10 x g).
Range	10 to 6900 rpm (10 to 9990 x g).
Temperature Control:	
Type	Digital Key Switch.
Increments	1°C.
Range	-9°C to 39°C.
Accuracy	± 1°C.
Temperature Indicator:	
Type	Digital LED.
Increments	1°C.
Range	-20°C to 40°C.
Time Control:	
Type	Digital Key Switch.
Increments	One second.
Range	One second to 99 min., 59 sec., plus HOLD.
Accuracy	± 1 second.
Time Indicator:	
Type	Digital LED.
Increments	One second.
Range	One second to 99 min., 59 sec., plus HOLD.
$\int w^2 dt$ **Control:**	
Type	Digital Key Switch.
Range	0 to 9.9 x 10^{16} Radians squared per second. Digital readout indicates accumulated $\int w^2 dt$ to two significant figures and exponential notation. Can be used to terminate a run at a preselected value.
$\int w^2 dt$ **Indicator:**	
Type	Digital LED.
Range	0 to 9.9 x 10^{16} Radians squared per second. Readout indicates accumulated $\int w^2 dt$ to two significant figures and exponential notation.
Program Storage	Ten panel setups plus manual.
Guard Bowl Inside Diameter	58.1 cm (22.9 in).
Refrigerant	R-502, 1.021 kg (36 oz).
Operational Head Pressure*	220-280 psig @ 0°C.
Operational Suction Pressure*	10-15 psig @ 0°C.
Power Requirements (Nominal)	200, 220, or 240VAC,±10%,50/60Hz, single phase, 30 Amps.
Power Consumption (Operating)	3750 Watts @ 20°C (68°F).
System Heat Output (Typical)	7500 BTU/hr.
Centrifuge Dimensions:	
Height with cover open	161 cm (63.3 in).
Height with cover closed	109 cm (43.0 in).
Width	72.4 cm (28.5 in).
Depth	86.4 cm (34.0 in).
Volume	1.2 cu. m (41 cu ft).
Centrifuge Weight	291 kg (641 lb).
Shipping Weight	327 kg (720 lb).
Packing Case:	
Height	147 cm (58.0 in).
Width	81 cm (32.0 in).
Depth	107 cm (42.0 in).
Volume	1.3 cu. m (45 cu ft).

* Note. These pressures are used in service procedures. Pressures shown on the instrument dataplate are proof U.L. (design) test pressures and not operational pressures.

1.4 WARRANTY

International Equipment Company (hereafter called IEC) warrants that it will repair or replace, free of charge to an authorized dealer of IEC any part which fails within one (1) year after delivery to the original customer because of defective material or workmanship, provided it does not fall under the exceptions and conditions specified in the warranty given with the instrument. Such exceptions and conditions include, but are not limited to, failure of parts due to natural wear, accident, neglect or operation in a manner not prescribed in the operating instructions supplied with the instrument. IEC agrees to correct either by repair, or, at its election, by replacement, any defects of material or workmanship in an IEC rotor which develop within seven (7) years after delivery of the IEC rotor to the original customer by IEC or its authorized dealer, provided that investigation and inspection by IEC discloses that such defect developed under normal and proper use. Should an IEC centrifuge be damaged due to a failure covered by this warranty of a rotor, IEC will supply free of charge all centrifuge parts required for repair. The foregoing expresses IEC's sole warranty with respect to the instrument. THIS WARRANTY IS MADE IN LIEU OF ANY AND ALL OTHER WARRANTIES AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED AND EXCLUDED. IEC AND ITS AUTHORIZED DEALERS WILL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES, LOSS OR EXPENSE ARISING FROM THE IMPROPER USE OF THE INSTRUMENT OR FROM ANY OTHER CAUSE WHATSOEVER. IEC will not honor any other warranty given by the authorized dealer which is different from the warranty given by IEC. This warranty is not assignable and is operative only in favor of the original customer to whom this warranty is delivered.

1.4.1 DEALER OBLIGATION UNDER WARRANTY

A customer requesting service for an instrument during the period covered by warranty should receive a response within a 48-hour period, from the authorized dealer who sold the instrument. If this obligation is not met and the customer so advises IEC, such authorized dealer will be notified of, and responsible for, the action taken, and expense incurred, by IEC in satisfying the customer.

1.4.2 DISCLAIMERS AND EXCLUSIONS

The instruction manual supplied with this instrument includes a service troubleshooting chart. However, you are under no obligation to locate or remedy any service problem. You hereby release and forever discharge IEC, its successors, assigns, subsidiaries, affiliates, officers, agents, and employees from any and all claims, demands and liabilities in law or equity, of any nature, based upon, arising out of, or resulting from locating, remedying or attempting to locate or remedy any service problem. Should service be required, contact the dealer from whom you purchased this instrument to obtain service by factory-trained personnel.

The information included in this instruction manual is believed adequate for the operation and intended use of this instrument. If the instrument is to be used for any purpose exceeding or deviating from the capabilities specified herein, then written confirmation or acceptibilty for such purpose should be obtained from IEC. Failure to do so will affect the warranty, and IEC will not guarantee any results nor assume any obligation or liability arising from such confirmed action.

The warranty is conditional upon operation using power source requirements specified on the plate affixed to the instrument. IEC reserves the right to change, alter, modify, or improve any of its instruments without any obligation whatever to make corresponding changes to any instrument previously sold.

1.5 ORDERING INFORMATION AND FACTORY RETURNS

To obtain service and/or replacement parts under warranty, you should contact the authorized IEC dealer from whom you purchased your instrument, or write directly to IEC, 300 Second Avenue, Needham Heights, Massachusetts 02194, Attention: Service Manager. Your correspondence should include the model and serial number of your instrument, the date of its delivery, and the name of the dealer from whom you purchased it. IEC will not accept goods returned without proper authorization. A "Returned Goods Authorization" (RGA) must be obtained through a dealer and accompany the prepaid return shipment.

To obtain service and/or replacement parts not under warranty, or to order additional accessories, you may contact any authorized IEC dealer.

NOTE: In the event you wish to return the instrument or any part, you must comply with the following:

1. If the instrument or any part has been exposed to, or used to process, dangerous pathogenic or radioactive material, you are required to decontaminate the instrument or part being returned to insure there is no radioactivity or harmful bacteria present and to advise us accordingly.

2. Decontaminate the instrument or any part that may have accumulated blood or any other chemical deposit by using standard laboratory procedures. Should this instrument or any part be received in a condition we consider to be a potential hazard to our personnel, it will be returned to you unrepaired, at your expense.

1.6 REGISTRATION OF INSTRUMENT

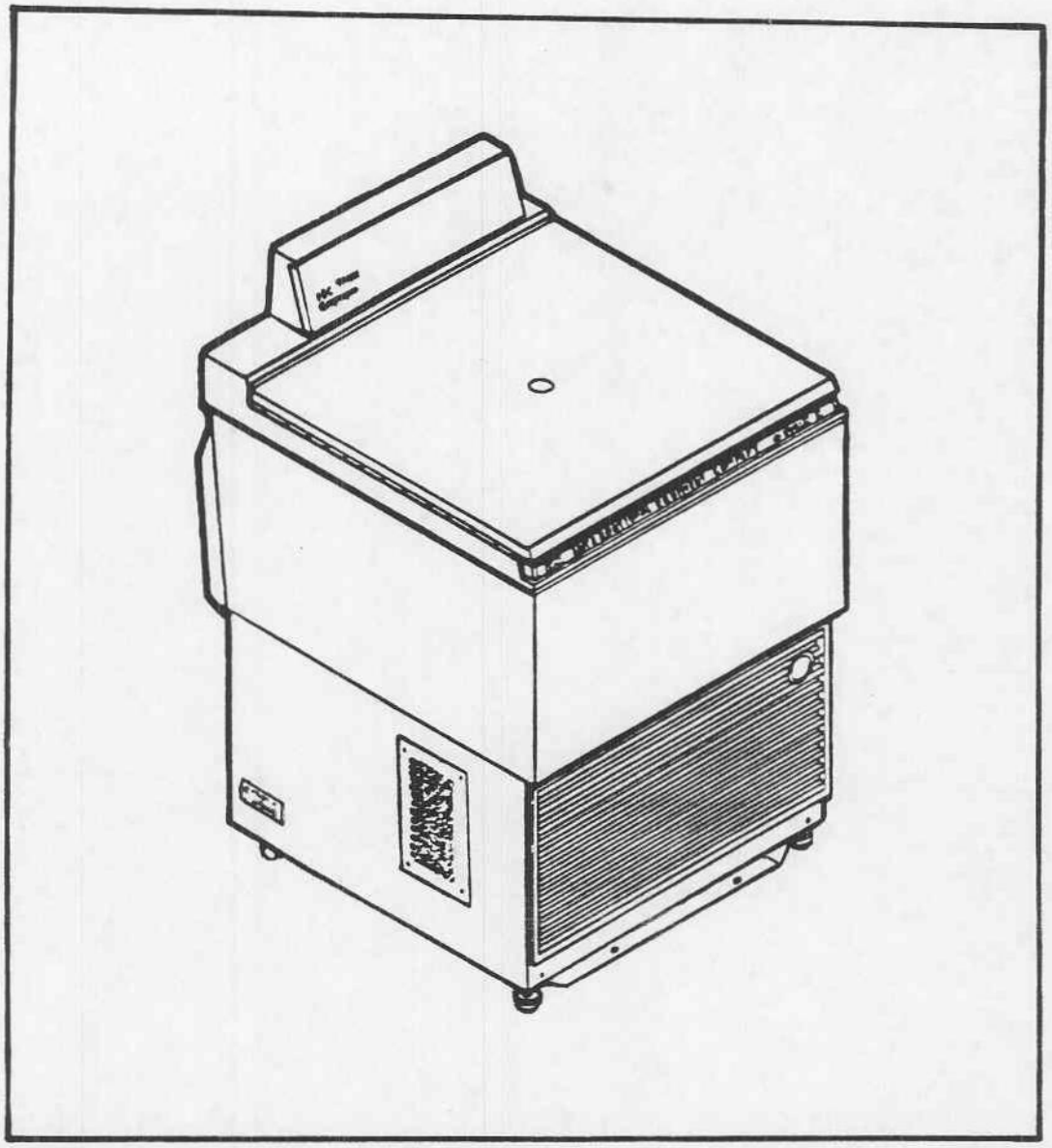
For registration purposes please fill out the Warranty Registration / Installation Report form supplied with the instrument. Return the completed form to IEC.

Table 1-2 EQUIPMENT SUPPLIED

Quantity	Description	IEC Catalog No.
1	PR-7000M Centrifuge	3497
1	Hold-Down Bracket	49919
1	Rotor-Stabilizing Kit	45298
1	Windshielded, Swinging Bucket Rotor	966 which includes-
-6	Cups (Buckets)	5027
-6	Domes (Caps)	5026
-6	"O" Rings	47824
-6	Balancing Discs	579
1	Bottle, 1 oz. Bonded Lubricant Coating	7133
1	Spare Parts Kit	49890
1	Spare Brush Kit	41775
1	Steel Wrench	1787
2	Instruction Manual	IM-250A

Table 1-3 EQUIPMENT REQUIRED BUT NOT SUPPLIED

Item	Designation	Description	Function
1	General Radio Gen Rad-1546 or equivalent	Phototachometer	Measure RPM (speed)
2	Precision Level		Level centrifuge
3	Brown& Sharpe Model 703-1 or equivalent	Dial Test Indicator Set 0 - .030", ± .015"	Measure total indicated readout
4	----------	Refrigeration Service Gauges	Check refrigeration



IEC PR-7000M

GENERAL-PURPOSE REFRIGERATED CENTRIFUGE

SECTION TWO

INSTALLATION

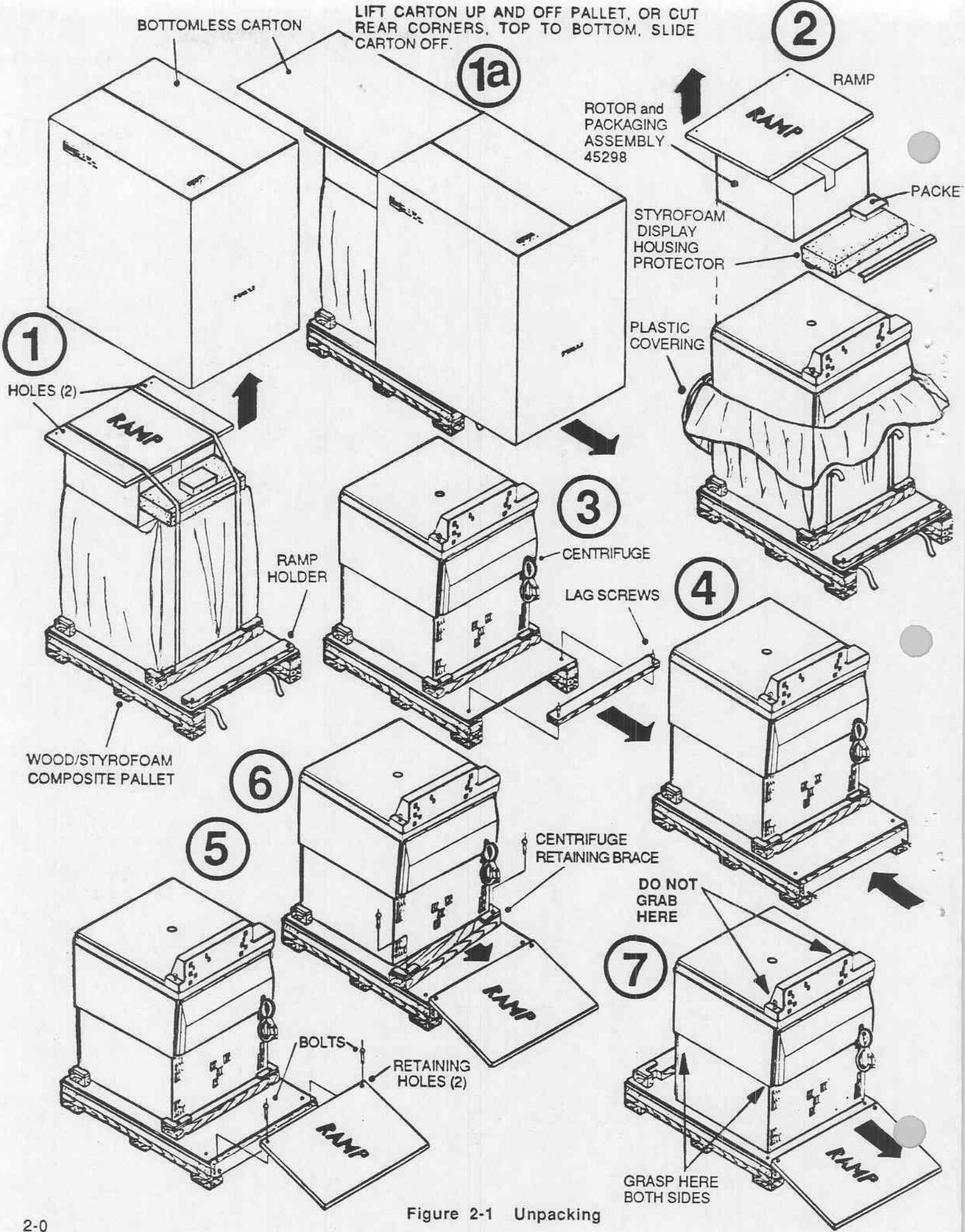


Figure 2-1 Unpacking

2.0 INSTALLATION

2.1 General

The centrifuge is packed and shipped in a special packing case designed to protect it from hazards in transit. The packing case includes a wood/styrofoam pallet and a bottomless cardboard carton. The carton should be inspected by receiving before acceptance from the shipper. The packing case is then moved to the operating or installation area, the centrifuge is removed from the packing case, and inspection is made for damage or other defects. Completeness of the shipment is also ensured by checking each item against the delivery receipt.

2.2 Receiving Inspection

Before signing the delivery receipt and accepting the shipment, inspect the carton for any signs of mishandling, such as broken or dented sides. Any observed damage must be stated, in writing, on the delivery receipt ***before*** signing the receipt. A normal or undamaged carton does not necessarily ensure that the contents are undamaged. If mishandling or shipping damage is suspected, contact the office of the carrier so that a representative may be called in to witness the unpacking. IEC is not responsible for damage incurred in transit.

2.3 Unpacking

These instructions are also on the packing carton. Refer also to Figure 2-1.

CAUTION

ONLY AUTHORIZED PERSONS SHOULD UNPACK THE CENTRIFUGE.

The centrifuge weighs approximately 641 lbs. Unpacking and installation requires the service of two people.

- Use a forklift or a roller lift to move the carton to the intended operating location. Keep all the shipping documents.

- Cut, and remove, the straps from around the carton and pallet. Remove the staples at the bottom of the carton.

- The carton does not have a bottom; lift the carton straight up and off the centrifuge and pallet.

NOTE

If it is not possible to lift the carton straight up and off the centrifuge and pallet because of an obstruction, or a low ceiling, simply cut the two rear corners of the carton from top to bottom. Then lift the rear flaps of the carton up and over the top. Pull the carton away from the centrifuge and the pallet.

Inspect the centrifuge for obvious damage; if none, proceed.

- Remove the packet at the top rear of the centrifuge. The packet contains instructions, the instruction manual, a steel rotor wrench, two program switch keys, spare fuses and brushes, and a bag containing two ramp bolts. Be sure to keep all of these items.

- Remove the ramp, the display housing protector, and the rotor and packaging assembly 45298, from the chamber cover. Be sure to keep all of these items. Refer to Figure 2-1A for the contents of the rotor and packaging assembly 45298.

- Locate the ramp holder mounted on the top edge of the pallet (just behind the centrifuge). Use a wrench to loosen the two lag bolts on the ramp holder just enough to move it to the top rear of the pallet as a support for the ramp. Take the two bolts out of the bag and put them into the other holes in the ramp. These will be used as ramp-retaining studs. Place the ramp so that the two bolts go into the matching holes in the top of the ramp holder now located at the rear of the pallet.

- Use a wrench to remove the two bolts holding the centrifuge retaining brace to the pallet,and located under the ***rear*** of the centrifuge. Hold the centrifuge, then use a hammer to carefully remove the retaining brace from under the rear of the centrifuge. The centrifuge rear wheels will now be on the pallet. These wheels are swivel casters. With a partner, be careful to get and keep, a good grip on both sides of the middle front and rear of the centrifuge. **Do not grip, or use as a support, the control panel housing.**

- Slowly and carefully work the centrifuge off the pallet and onto the ramp and then onto the floor.

- Roll the centrifuge to the desired location but do not plug it in. Leave sufficient space for inspection.

- Carefully inspect the centrifuge for external damage. Any damage discovered, which is attributable to mishandling or shipping, should be documented and a signed inspection report should be furnished to the shipping company.

Proceed to the Setup and Installation Procedure that follows.

2.3.1 Rotor and Packaging Assembly

The rotor is packed in a special cardboard box as shown in figure 2-1A.

- Open the box and remove the cover support which contains the windshield rotor cover.

-Remove the top insert that covers the plastic rotor bag.

-Remove the bag. Open the bag. Note that there is a cup block between each cup.

CAUTION

These 6 blocks are used to keep the rotor cups from swinging during shipment. They are put in the rotor if the centrifuge is to be moved within the facility or re-packed. *Do not* leave them in during operation.

-Remove the roll of relective tape 49934 that is in the bottom of the box.

This roll of reflective pressure-sensitive tape is included in the box and is to be installed on the rotor windshield knob as a cooperative target when a photo-tachometer speed check is desired. Refer to Section Four, Service.

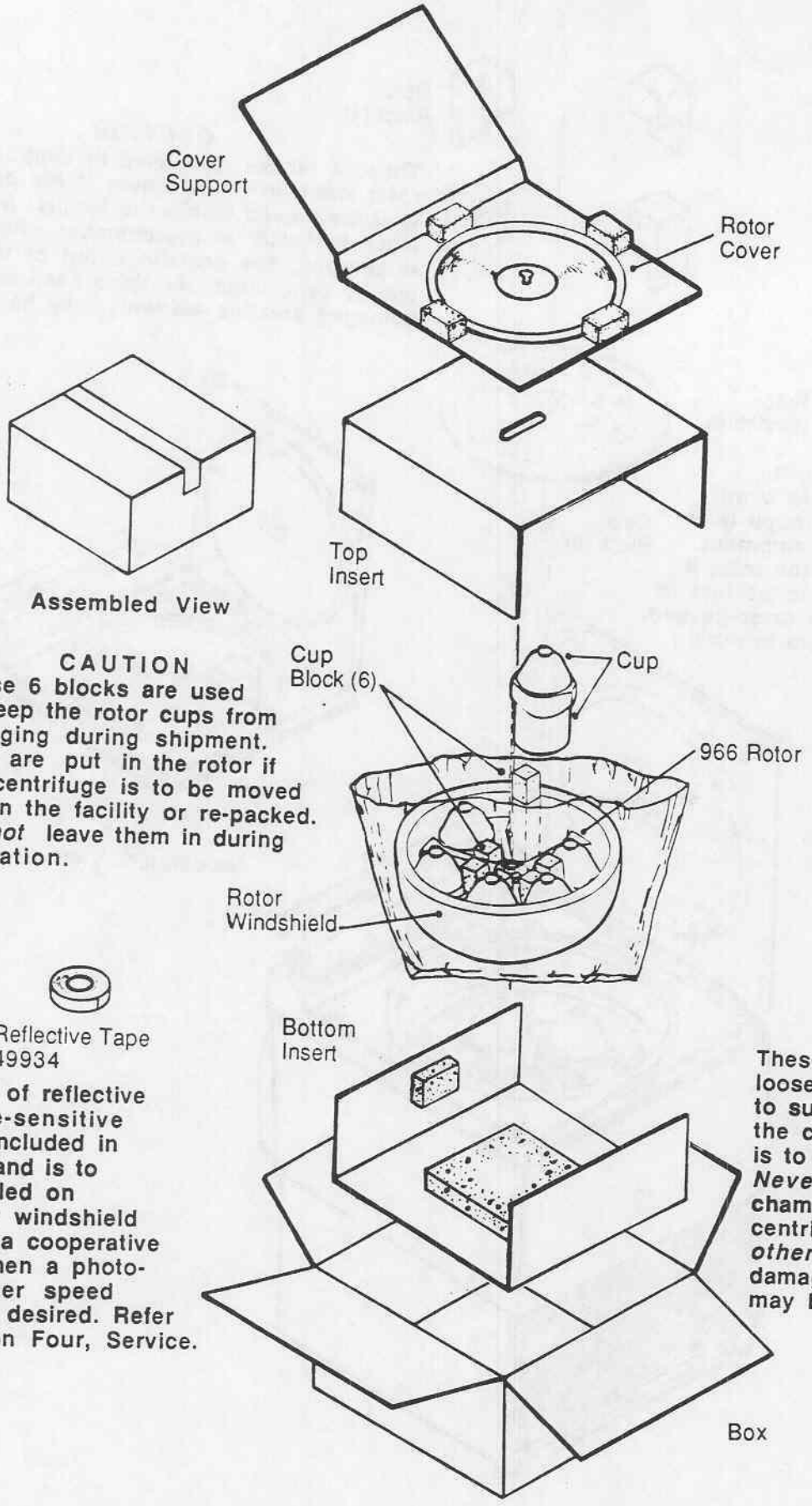
-Remove the four rotor blocks that are also in the bottom of the box. These blocks and the six cup blocks comprise the rotor stabilizer kit 45298.

CAUTION

These 4 blocks are shipped loose in the box and are used to support the rotor when in the chamber *if* the centrifuge is to be moved within the facility. *Never* leave the rotor in the chamber when re-shipping the centrifuge out of the facility *otherwise* the drive shaft will be damaged.

Place these four blocks 90-degrees apart, and the six cup blocks between the cups, as shown in Figure 2-1B whenever the centrifuge is to be moved within the facility.

Keep the box and its parts for later use and storage of the rotor.



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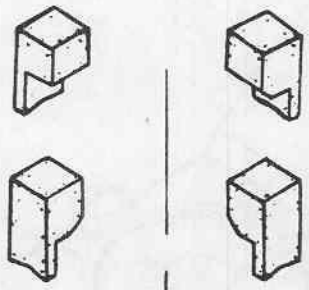
These 4 blocks are shipped loose in the box and are used to support the rotor when in the chamber *if* the centrifuge is to be moved within the facility. *Never* leave the rotor in the chamber when re-shipping the centrifuge out of the facility *otherwise* the drive shaft will be damaged and the warranty may be voided.

Figure 2-1A Rotor and Packaging Assembly 45298

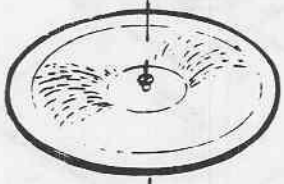


Rotor
Block (4)

CAUTION

These 4 blocks are used to support the rotor when in the chamber if the centrifuge is to be moved within the facility. *Never* leave the rotor in the chamber when re-shipping the centrifuge out of the facility *otherwise* the drive shaft will be damaged and the warranty may be voided.

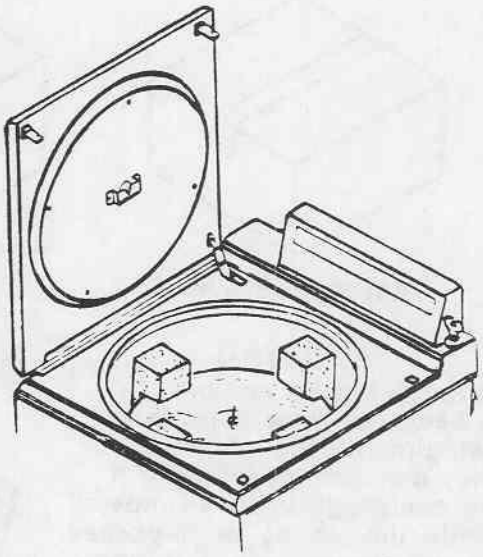
Rotor
Windshield



CAUTION

These 6 blocks are used to keep the rotor cups from swinging during shipment. They are put in the rotor if the centrifuge is to be moved within the facility or re-packed. *Do not* leave them in during operation.

Cup
Block (6)



Assembled View

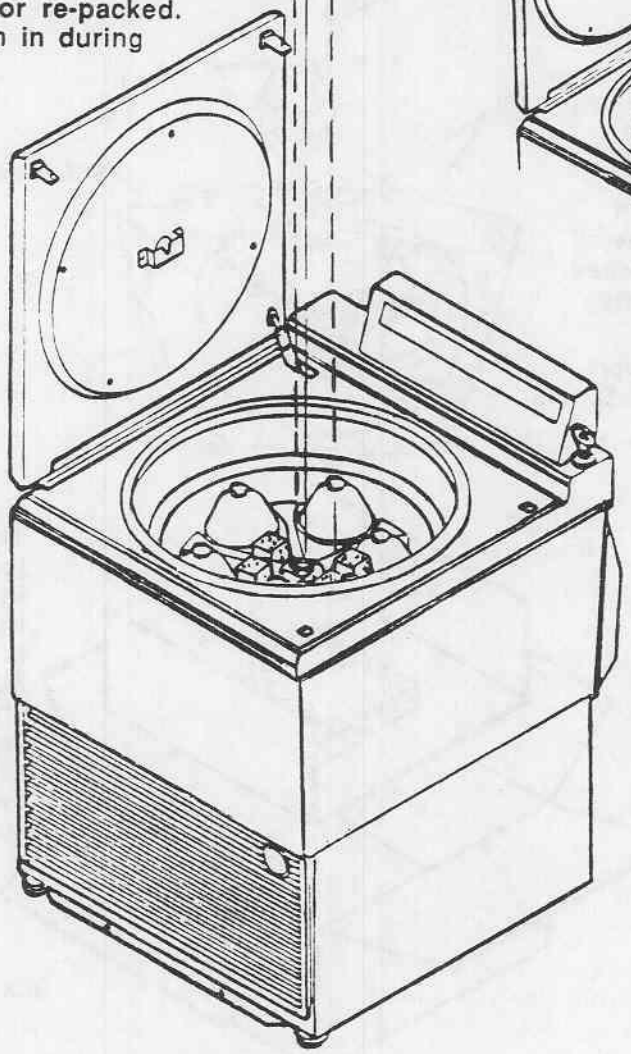


Figure 2-1B Rotor Stabilizer Kit

IMPORTANT

THIS INSTRUCTION MANUAL MAY NOT CONTAIN INFORMATION ON ALL CHANGES THAT HAVE OCCURRED TO THE SUBJECT INSTRUMENT SINCE THE MANUAL ISSUE DATE. IT WAS PREPARED FOR USE BY IEC AUTHORIZED FACTORY-TRAINED SERVICE OR DEALER PERSONNEL WHO ARE KEPT CURRENT THROUGH A PROGRAM OF SERVICE LETTERS AND BULLETINS AND TRAINING SEMINARS.

WARNINGS AND CAUTIONS

THIS MANUAL CONTAINS **WARNINGS** AGAINST OPERATING PROCEDURES WHICH COULD RESULT IN AN ACCIDENT AND/OR PERSONAL INJURY. IT ALSO CONTAINS **CAUTIONS** AGAINST PROCEDURES WHICH COULD RESULT IN DAMAGE TO YOUR INSTRUMENT OR ACCESSORY EQUIPMENT. IF YOU DO NOT READ THIS MANUAL YOU WILL MISS IMPORTANT INFORMATION

OBSERVE ALL WARNINGS AND CAUTIONS

2.4 Setup and Installation

CAUTION

THE FOLLOWING PROCEDURES ARE TO BE COMPLETED ONLY BY QUALIFIED PERSONNEL. DO NOT ATTEMPT TO OPERATE THIS CENTRIFUGE BEFORE THOROUGHLY READING THE *OPERATING SECTION* OF THE MANUAL. WARNING: DO NOT PLUG IN THE CENTRIFUGE POWER CORD AT THIS TIME.

1. Remove the louver at the lower-front, and the rear cover panels at the rear, of the cabinet.

NOTE

The centrifuge has been designed to protect the user by preventing the opening of its chamber cover during operation. However, during installation, an electrical power failure, and for servicing purposes, it is possible to bypass this safety, cover latch interlock as follows.

2. Remove the plug button from the front, top-right corner of the cabinet. Insert a rigid, 1/8th-inch shaft-diameter tool, such as a screwdriver, approximately 3/4-inch straight into the access hole. The cover interlock will release and the cover will open.

3. Remove the tool and replace the plug button.

WARNING

The above procedure should *never* be performed when the rotor is still turning as opening the cover then will expose rotating parts. *Never* attempt to both override the interlock and to operate the centrifuge.

4. Inspect all areas for loose: components; printed circuit board connections, connectors and mounting hardware.

5. Ensure that the condenser fans rotate freely and that fan blades are clear of the condenser cooling shroud and wiring harnesses.

6. Rotate the rotor drive shaft counter-clockwise (CCW) by hand to determine that the shaft and bearings were not damaged in transit.

7. Do not close the chamber cover at this time.

8. Do not replace the louver at this time.

2.4.1 Line Voltage Check

This procedure is used to ensure that the electrical line voltage is compatible with the electrical requirements of the centrifuge.

WARNING

This procedure requires qualified service personnel to make connections located in an electrical shock area where potential lethal voltages are present. Exercise *extreme caution* when in this area.

The centrifuge should have its own separate branch circuit so that line load variations will be minimized. The line voltage supply must be a standard three-wire grounded single-phase circuit. It must be located within six feet (1.8 meters) of the centrifuge. The power outlet must be easily accessible during maintenance and thus allow for a rapid disconnect of the centrifuge in case of an emergency.

NOTE

A 250 volt, 30 ampere 60 Hz single-phase, 2-pole, grounding, twistlock receptacle, Hubbell Cat. No. 2620, (NEMA L6-30R) is required to mate with the Hubbell Cat. No. 2621, (NEMA L6-30P) plug attached to the power cord.

Power line voltage - and - frequency requirements are shown on the dataplate located at the rear of the centrifuge. Use an AC voltmeter to measure and ascertain that the voltage available at the power socket matches that of the dataplate.

WARNING

TO AVOID AN ELECTRICAL SHOCK, THE POWER CORD *MUST* BE PLUGGED INTO A GROUNDED OUTLET, *NEVER* REMOVE THE GROUNDING PRONG FROM THE POWER PLUG OR USE ANY ADAPTER WHICH DEFEATS, OR DOES NOT COMPLETE, THE POWER GROUND CIRCUIT. DO NOT PLUG IN THE CENTRIFUGE POWER CORD AT THIS TIME.

- The line voltage must be within this limit:

200 - 240 VAC

If outside this limit, an external voltage step-up, or step-down, transformer will be required. Also, line frequency ***must be*** between 48 to 62 Hz.

Refer to the following paragraph.

2.4.2 Electrical Connections

The centrifuge is set up and shipped from the factory **for 240 VAC, 50 Hz, and 60 Hz, power line** operation.

- Disconnect the power cord.

- Locate the terminal strip on the autotransformer T1 shown in Figures 2-2 and 2-3.

- Remove the plastic autotransformer cover. The leads from T1 go directly to one row of terminal screws on the strip.

CAUTION

DO *NOT* ATTEMPT TO CHANGE THESE LEADS. THE CHANGE IS TO BE MADE ON THE ***OTHER, VOLTAGE - MARKED*** ROW OF TERMINAL SCREWS.

The motor-controller red wire, **#135 *must always*** be connected to the 240 Volt terminal (tap) of the autotransformer, T1.

- For 60 Hz operation - The brown AC-input wire, **#131** and the brown compressor wire, **#134** must be connected to the autotransformer T1 terminal connections as follows.

Measured Line Voltage	Connect Line Voltage Wire #131 to Tap:	Connect Compressor Wire #134 to Tap:	Resulting Voltage to Compressor	Connect Controller Wire #135 to Tap:	Resulting Voltage to Motor Controller
200	200	220	220	240	240
210	200	220	231	240	252
220	220	220	220	240	240
230	220	220	230	240	251
240	240	240	240	240	240

CAUTION

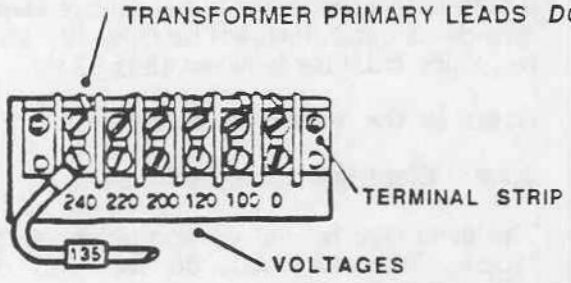
Failure to follow the above instructions may result in damage to the centrifuge.

- For 50 Hz operation - The brown AC-input wire, **#131** and the brown compressor wire, **#134** must be connected to the autotransformer T1 terminal connections as follows.

Measured Line Voltage	Connect Line Voltage Wire #131 to Tap:	Connect Compressor Wire #134 to Tap:	Resulting Voltage to Compressor	Connect Controller Wire #135 to Tap:	Resulting Voltage to Motor Controller
200	200	200	200	240	240
210	200	200	210	240	252
220	220	220	220	240	240
230	220	220	230	240	251
240	240	200	200	240	240

CAUTION

Failure to follow the above instructions may result in damage to the centrifuge.



The motor controller wire **#135 *must always*** be connected to 240V tap (50 or 60 Hz) measured line voltages.

Figure 2-2 Autotransformer, T1 Connections

- Replace the plastic autotransformer cover.

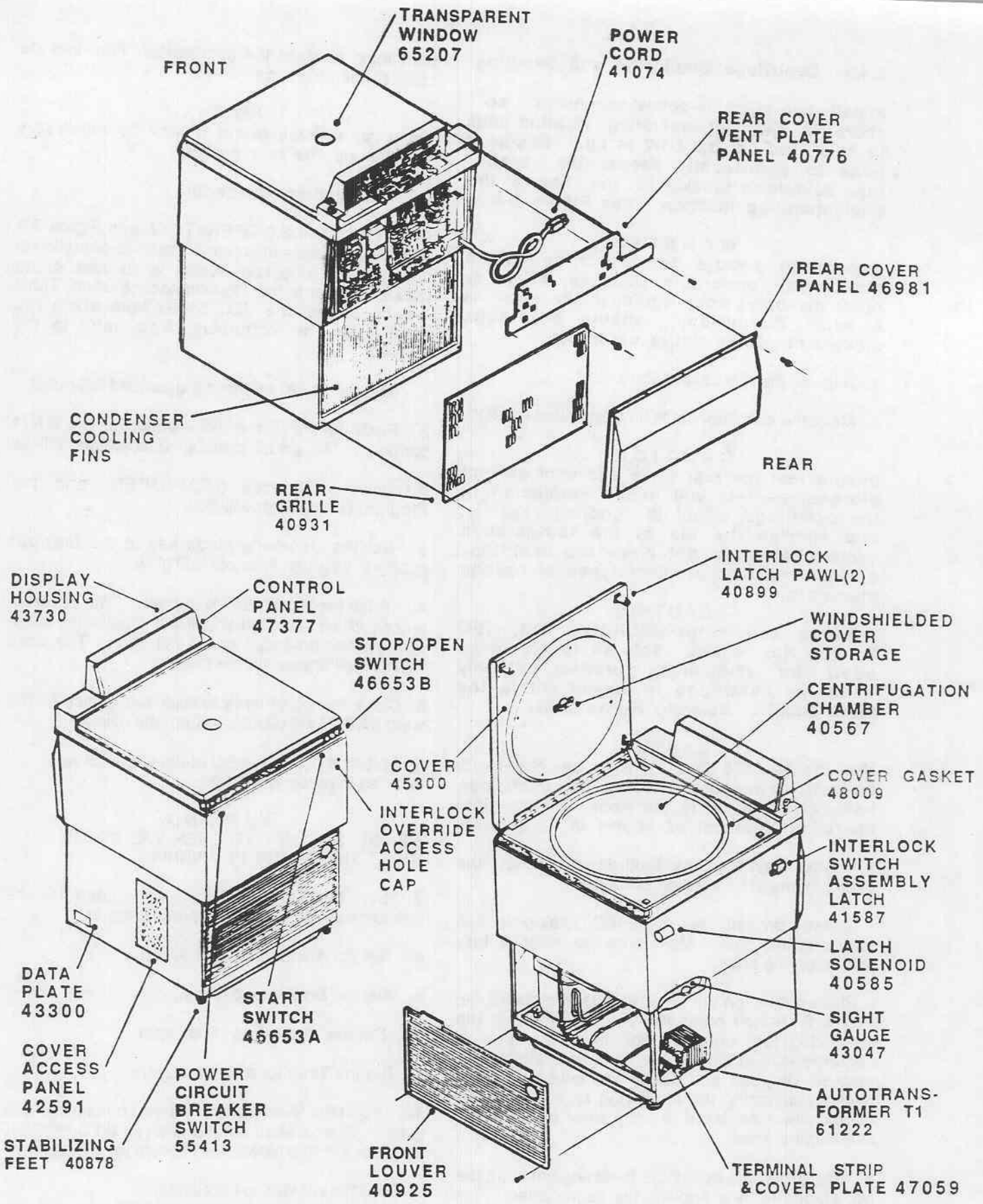


Figure 2-3 Centrifuge Installation

2.4.3 Centrifuge Stabilizing and Securing

Install two machine-screw expansion anchors in the final operating location floor to hold two 3/8 Dia.1-1/2 in Lg. Hex-head bolts to permanently secure the centrifuge hold-down bracket to the floor at the final operating location. See Figure 2-4.

WARNING

Failure to secure the centrifuge to a substantial (preferably concrete, brick, or other masonry) floor would, in the event of a rotor disruption, enable hazardous movement of the entire centrifuge.

1. Replace the rear cover panels.

2. Move the centrifuge to its final operating location.

CAUTION

Ensure that the rear grille and vent are not blocked, as this will impair ventilation of the centrifuge, affect the cooling capacity, and shorten the life of the refrigeration system. Also, do not place the centrifuge against radiators or other types of heating elements.

CAUTION

Remove the rotor-stabilizing kit, IEC Catalog No. 45298. This kit is *not to be used* for re-shipping purposes but only when the centrifuge is moved within the same facility. Refer to Figure 2-1B.

CAUTION

Use the two 3/8 Dia. 1-1/2 in Lg. Hex-head bolts to permanently secure the centrifuge hold-down bracket to the floor at the final operating location as shown in Figure 2-4.

3. After securing the hold-down bracket, the centrifuge must be levelled as follows:

- Install a properly balanced IEC Catalog No. 966 rotor onto the shaft. Make sure the rotor is fully seated on the shaft.

- Place a level on the rotor to level the centrifuge. Use a 9/16-inch open-end wrench to adjust the stabilizing feet until the bubble in the level is centered side-to side in the chamber. Rotate the rotor 90 degrees and center the bubble front-to-back by adjusting the stabilizing feet. When the bubble stays centered in any rotor position, the centrifuge is level.

4. Check that the centrifuge is resting firmly on the two stabilizing feet and the two rear casters. Try rocking the centrifuge by alternately pressing down on the back corners. If there is any movement of the centrifuge, readjust the appropriate front foot to stabilize the centrifuge.

NOTE

On very uneven floors it may be necessary to shim up the rear casters.

2.5 Installation Checkout

Refer to Section 3.0 OPERATION, and Figure 3-1 as needed. In case of improper machine operation at any of these checkout steps, or in case of no operation, refer to the Troubleshooting Chart, Table 4-1, or, contact the IEC dealer from whom you purchased the instrument. Also, refer to the warranty.

1. Plug the power cord into a grounded AC outlet.

2. Push the **Power** switch button to the **ON/1** position. The actual chamber temperature will be displayed. The red **STOP/OPEN** and the Program **Off** indicator will glow.

3. Set the Operating Mode key to the **Manual** position. Its green indicator will glow.

4. Push the **STOP/OPEN** button. The cover interlock will be activated and it will release the latch. The counter-balanced cover will open. The word **LATCH** will appear on the display.

5. Close the cover firmly to latch and to lock it. The word **LATCH** will disappear from the display.

6. Enter the number (966) of the rotor that was installed in paragraph 2.4.3.

WARNING

***NEVER* ATTEMPT TO OPEN THE COVER WHILE THE ROTOR IS SPINNING.**

7. Set the **Temp C°** to **+4**. Listen for the operating sound of the compressor motor.

8. Set the **Accel** to **0** (slow accel).

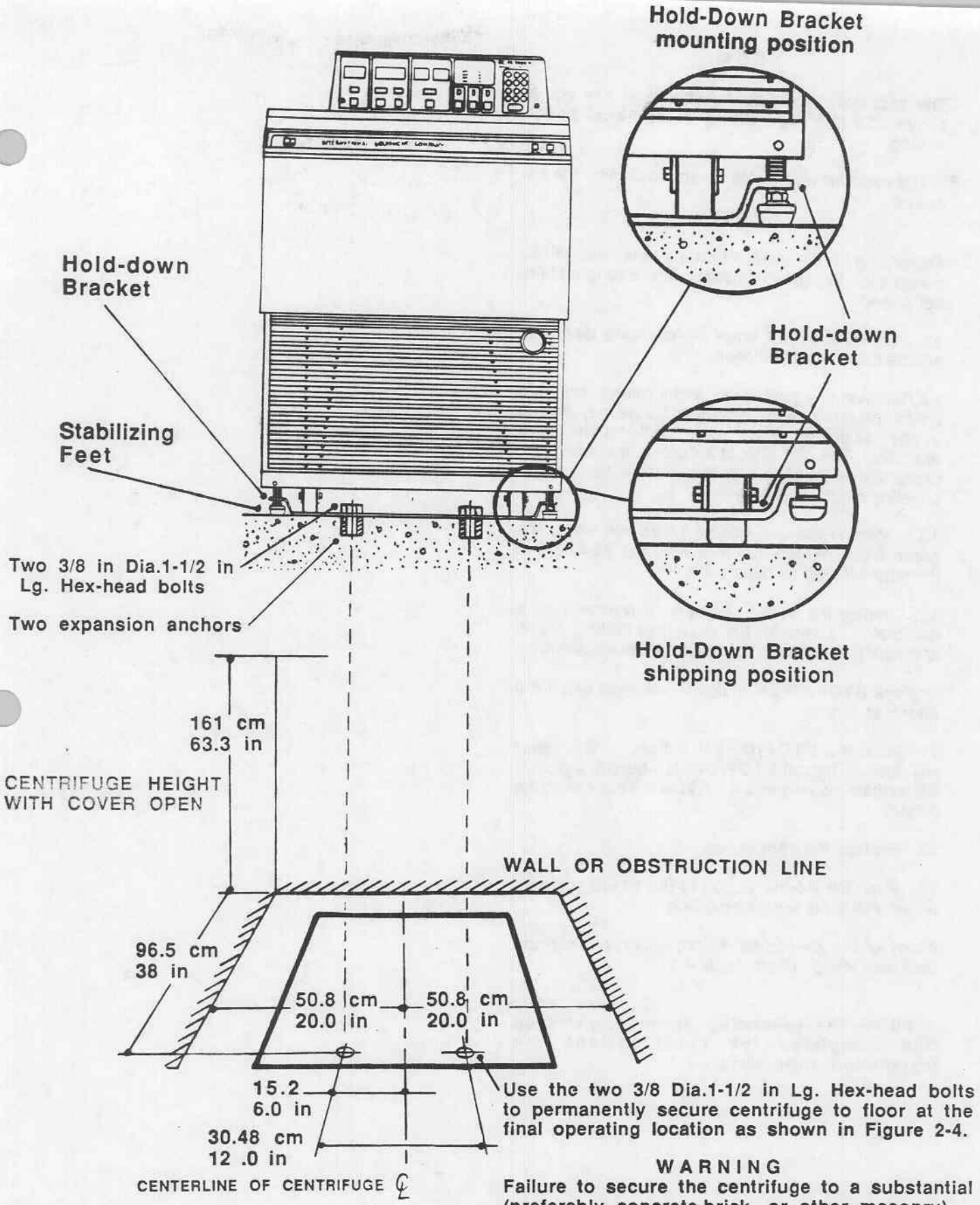
9. Set the **Brake** to **0** (coast).

10. Set the **Speed** to **3000** rpm.

11. Set the **Time** for a **5**-minute run.

12. Push the **Start** button. Its green indicator will glow. After a short interval the red **STOP/OPEN** indicator will stop glowing to indicate rotor motion.

- The rotor will start to accelerate.
- Before the speed reaches **100** rpm set the **Accel** to **9 (maximum)**. Notice the increase in acceleration.



Use the two 3/8 Dia.1-1/2 in Lg. Hex-head bolts to permanently secure centrifuge to floor at the final operating location as shown in Figure 2-4.

WARNING

Failure to secure the centrifuge to a substantial (preferably concrete,brick, or other masonry) floor can, in the event of a rotor disruption, cause hazardous movement of the entire centrifuge.

Figure 2-4 Permanent Mounting-Hole Dimensions

NOTE

The acceleration will be ***maximum*** at any speed above **250** rpm ***regardless*** of the **Accel** switch setting.

- The rotor will accelerate to, and maintain, the set speed.

NOTE

Depending on the installed rotor it takes one-to-two minutes for the speed to stabilize to ±10 rpm of the set speed.

13. Check that the timer is "counting down" to ensure that it is operational.

14.Remove the protective sight gauge cap and check the refrigeration system sight gauge, located at the lower-right-front inside wall of the base assembly. The disc should be green. If bubbles are present, or if the disc is yellow, refer to the trouble-shooting chart, Table 4-1.

15. When the five minute timed run ends, the green **Start** button indicator will stop glowing and the rotor will start to decelerate.

16. Change the **Brake** setting from **0** (coast) to **9** (full brake). Listen for the increased-braking sound and notice the change in the rate of deceleration.

The red **STOP/OPEN** indicator will glow when the rotor is at **0** rpm.

17. Push the **STOP/OPEN** button. The cover will open. The red **STOP/OPEN** button indicator will remain glowing and a **LATCH** will appear on the display.

18. Replace the front louver.

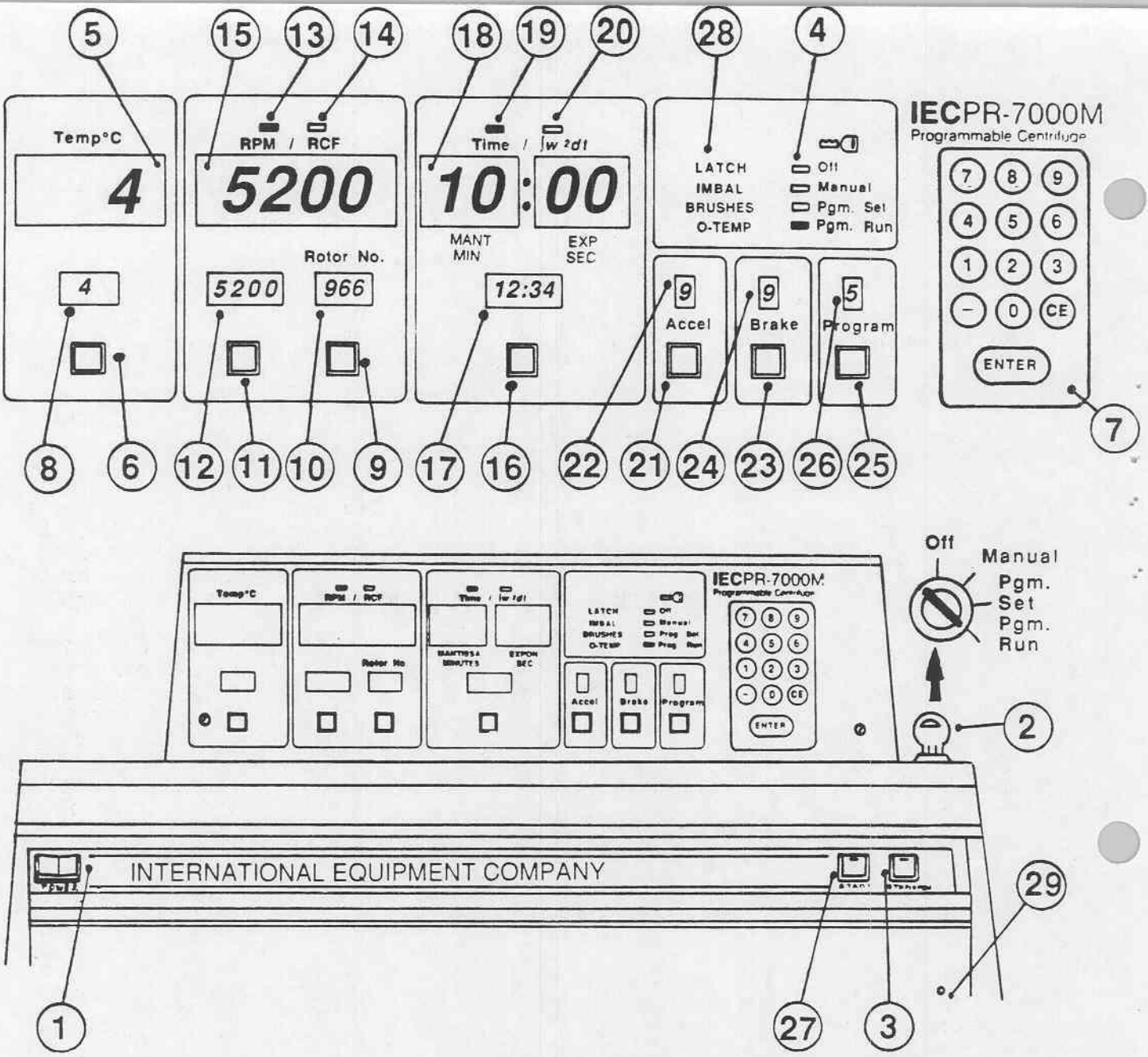
19. Push the **Power** button to the **OFF/0** position. All the indicators will stop glowing.

If any of the preceding do not occur, refer to the troubleshooting chart, Table 4-1.

If all of the preceding seem normal then this completes the checkout and the installation procedure.

SECTION THREE

OPERATION



1. **Power (OFF/O - ON/I)** Switch.
2. Operating Mode Program Key/Switch.
3. **Stop**-Run / **Open**-Cover Switch/Indicator.
4. Operating Mode Key/Indicator.
5. Actual **Temp**erature **C°** Indicator.
6. Set **Temp**erature **C°** Switch.
7. **ENTER** Keypad.
8. Set **Temp**erature **C°** Indicator.
9. Set **Rotor No.** Switch.
10. **Rotor No.** Indicator.
11. Set Speed **(RPM) / RCF** Switch.
12. Set Speed **(RPM) / RCF** Indicator.
13. **RPM** Mode Indicator.
14. **RCF** Mode Indicator.
15. Actual Speed **RPM/RCF** Indicator.
16. Set **Time (MIN/SEC) / $\int w^2 dt$ (COEF/EXP)**Switch.
17. Set **Time (MIN/SEC) / $\int w^2 dt$ (COEF/EXP)** Indicator.
18. Actual **Time (MIN/SEC) / $\int w^2 dt$ (COEF/EXP)**Indicator.
19. **Time (MIN/SEC)** Mode Indicator.
20. **$\int w^2 dt$ (Mant/Exp.)** Mode Indicator.
21. **Acce**leration Rate Switch.
22. **Acce**leration Rate Indicator.
23. **Brake** (deceleration) Rate Switch.
24. **Brake** (deceleration) Rate Indicator.
25. **Program** Select Switch.
26. **Program** Indicator.
27. **Start**-Run Switch/Indicator.
28. Diagnostic Display: **LATCH / IMBAL**ance / **BRUSHES / Over-TEMP**.
29. Cover Interlock Bypass access (with cap).

Figure 3-1 Controls

3.0 OPERATION

3.1 General

This section contains instructions for the operation of the centrifuge and to acquaint the user with the various controls and indicators and the operating characteristics of the centrifuge. Use Table 3-1 for computing relative centrifugal force (RCF), Table 3-2 and 3-3 for choosing rotors and accessories, and Table 3-4 for derating information.

WARNING

Personal injury and machine damage is possible if this centrifuge is operated with unauthorized rotors.

3.2 Description of Operation

Centrifuge operation normally involves; applying power, selecting the program mode, opening the cover, installing a rotor with balanced accessories and a balanced load in the rotor, entering the rotor number, selecting the chamber operating temperature, acceleration rate, braking, speed/RCF and duration of the run (time / $\int w^2 dt$) cycle, closing the cover, starting the run cycle, stopping the run cycle, (the run cycle ends automatically at the end of a programmed timed or $\int w^2 dt$ run), opening the cover and removing the rotor. The following paragraph describes the controls used in operation.

3.2.1 Controls

All of the controls and indicators necessary to operate and monitor the centrifuge are located on the top-front edge of the cabinet, and on the control panel located on the tower at the top-rear of the cabinet. These are shown in Figure 3-1.

1. Power Switch.

This alternate-action, (**ON/1-OFF/O**) rocker switch and circuit breaker is used to control power to, and provide overload protection for, the centrifuge. If an electrical circuit overload occurs within the centrifuge the switch will automatically open thereby shutting the power off. If the overload condition is momentary, simply setting this switch off and on again will re-energize the centrifuge. If the overload is continuous the switch will not stay in the **ON/1** position. Set the switch to the **OFF/O** position when not in use unless the refrigeration system is desired to be on. The actual guardbowl temperature will be displayed, and the red **STOP/OPEN** indicator will glow, when the switch is in the **ON/1** position.

2. Operating Mode Program Key Switch

This four-position (**Off, Manual, Pgm Set, Pgm Run**) key-operated switch is used to select the overall mode of the centrifuge. It is used to select manual operation, or, to select up to 10 preprogrammed run setups (programs) for tamper-proof replication of set parameters. Indicators are associated with these positions. This switch is always used when the machine is stopped. If positions are changed during a run the associated indicator will glow to show the new key position but the actual mode will not change until the current run ends. The following modes are selectable.

Off - In this position the manual, previously-set temperature setting is used. The set temperature will be maintained if the cover is closed. However, the temperature cannot be changed. None of the other front panel controls can be changed and the machine can not be operated. Only the actual and set **Temp/°C** indicators will be displayed.

Manual - With the exception of the program control, when the switch is in this position the machine will operate normally as described below. All displays and control settings will be operable. Front panel settings will be maintained during mode changes.

Pgm Set - This switch position is used with the numeric and **ENTER** keypad to enable a program and to activate the **Program** select switch. After pressing the program number the set value displays change to those previously stored for that program. In this position the machine is inoperable but the user can recall and change programs. Also, the actual and the set temperature indicators will be displayed and the set switches are operable. The set temperature will be maintained if the cover is closed. When the switch is changed from this position the values of all settings will be retained with the selected program number.

Pgm Run - This switch position is used to recall and run a program. The program is selected by using the **Program** Select switch and the numeric and **ENTER** keypad.

3. Stop-Run/**Open Cover** Switch/Indicator.

This pushbutton switch/indicator is used to stop the run and to open the cover. When the run is stopped the remaining time (if in the timed mode) will remain displayed until the next run is initiated. (When the **Start** switch is pressed again the display reverts to the original setting). When the rotor stops spinning the red indicator in the

Stop/Open switch the actual display will stop

switch will glow. This signals that the rotor is stopped and that the cover may be opened by pressing the switch.
The word **LATCH** will appear on the diagnostic display when the cover is not completely closed.

NOTE

Once the centrifuge motor has been decelerated it *cannot* be restarted until the rotor stops spinning.

4. Operating Program Mode Key Indicator.

This small, green LED Indicator is associated with the four (**Off / Manual / Pgm Set / Pgm Run**) positions of the key-operated switch and is used to show the key switch position.

5. Actual **Temp**erature/**°C** Indicator.

This large, red LED indicator is used to monitor chamber operating temperature from -20°C to +40°C, in 1°C increments.

6. Set **Temp**erature/**°C** Switch.

This digital switch is used with the numeric and **ENTER** keypad to select any chamber operating temperature from -9°C to +39°C, in 1°C increments. The keypad is used to select the minus " - " sign, and the desired value. The highest and lowest temperature that can be achieved depends on the operating speed and the rotor being used. When any of the rotors, or accessories, are operated at speeds lower than their maximum, then lower temperatures can be attained. **NOTE: Precool the rotor and the rotor chamber prior to use when planning below-ambient-temperature operation.** The natural fan action of the rotating horizontal and angle rotors serves to maintain a uniform temperature within the chamber during operation. However, once the rotor stops turning, air no longer circulates throughout the chamber and temperature distribution becomes less uniform. To control material temperature more closely throughout the run, operate the rotor to be used at the desired temperature and at a speed of l000 rpm for about 15 minutes prior to placing the material in the rotor. If time is a factor refrigerate the rotor externally beforehand. If the refrigeration system temperature is left operating when the centrifuge is not in use the microprocessor will compensate for this idle condition. Once the selected temperature has been attained the compressor turns on and off (cycles) to maintain the set temperature. Temperature may be reset anytime during a run cycle. Obviously, a few minutes will pass before the new temperature is reached. For larger (± 7° C) changes in temperature set point, during operation, refer to (28) below.

CAUTION

The chamber is *not* designed as a storage refrigerator. *Do not* store food or drink in the chamber as it may be contaminated if the chamber has not been kept biologically clean. Also, *do not* store accessories in the chamber.

7. Numeric and **ENTER** Keypad.

This 13-key keypad is used to enter and edit the run and program parameters. The following keys comprise the keypad:

"0 through **9"** Used to enter parameter values.

"-" Used to enter the negative sign to obtain the minus temperature value.

"CE" Used to erase the most recently entered parameter, and to clear the display.

"ENTER" Used to lock in the entry.

8. Set **Temp**erature/**°C** Indicator.

This small green LED indicator is used to display the set chamber-operating temperature from -9°C to +39°C, in 1°C increments. For larger (± 7°C) changes in temperature set point, during operation, refer to paragraph **28: E00** below.

9. Set **Rotor No.** / Rotor Radius switch.

This dual-function switch is used with the numeric and **ENTER** keypad to select the installed IEC rotor part number (once entered the rotors maximum radius (without tube) is automatically entered internally to the machine). **Note, the rotor number must first be entered to ensure safe operation since the machine overspeed shutdown limits are rotor dependent.** This switch is also used to enter a different acceptable radius for the specific, previously-entered rotor. The rotors and their respective radii and maximum speeds in RPM are shown in Table 3-1.
NOTE. If an invalid rotor number or radius is entered **EEE** or **EE.E** will be displayed on the **Rotor No.** / Rotor Radius Indicator and the machine will not run until a valid number is entered. If the rotor number is changed the set value of RPM/RCF may change to insure operation within the rotor-speed limitation. Also, if the rotor is not installed **E0.4** will be displayed.

10. Rotor No. / Rotor Radius Indicator.

This green LED indicator is used to display the installed rotor, or, its respective maximum radius, or, if desired, a different acceptable radius. If there is abnormal machine operation a diagnostic number may be displayed on the indicator. Refer to **(28)** below.

11. Set Speed RPM/RCF Switch.

This dual-function switch is used with the numeric and **ENTER** keypad to select and display on the associated indicator, either rotor speed in revolutions per minute (RPM) from 100 to 6900 rpm, in 100 rpm increments, or, the relative centrifugal force (RCF) produced up to 9635 x g.

NOTE

The speeds selected should be equal to, or less than, the maximum rated speed for the rotor and accessories to be used as listed in the Speed and Force Data, Table 3-3. You cannot enter greater than maximum rpm, RCF, or radius limits for the entered rotor number.

The set speed RPM/RCF may be increased or decreased at any point during a run.

NOTE

If during operation the rotor exceeds the maximum speed by 5% for that rotor an **E06** will be displayed on the **Rotor No.** / Rotor Radius Indicator and the machine will shutdown and brake to a full stop.

All RPM/RCF entries will be rounded to the nearest 100 rpm, or nearest 10 x g, respectively.

12. Set Speed RPM/RCF Indicator.

This green LED indicator is used to display the set speed; either directly, the rotor speed in revolutions per minute (RPM) from 100 to 6900 rpm, in 10 rpm increments, or indirectly, the relative centrifugal force (RCF) up to 9635 x g at a maximum speed of 6900 rpm.

13. RPM Mode Indicator.

This green LED indicator is used to indicate that the machine is in the **RPM** Mode.

14. RCF Mode Indicator.

This green LED indicator is used to indicate that the machine is in the **RCF** Mode.

15. Actual Speed RPM/RCF Indicator.

This red LED indicator is used to monitor the actual rotor speed; either *directly* in revolutions per minute (RPM) from 100 to 6900 rpm or *indirectly*, the relative centrifugal force (RCF) up to 9635 x g at a maximum speed of 6900 rpm. The display is in 10 rpm increments.

16. Set Time / $\int w^2 dt$ Switch.

This dual-function switch is used with the numeric and **ENTER** keypad to select and display on the associated indicator, either; an untimed (Hold), a timed, or, to select an $\int w^2 dt$ run-cycle duration. The $\int w^2 dt$ integrator automatically keeps track of the accumulating centrifugal effect in the course of a run, including that taking place during acceleration and deceleration of the rotor.
The **untimed (Hold) mode** is selected by entering **0 : 00** for the set time. This mode is used for runs exceeding 99 minutes and 59 seconds; for continuous runs, or, when the timed mode is not desired. A green **HOL** will appear on the set **Time** / $\int w^2 dt$ indicator when in the hold mode. In this mode actual time displayed indicates a "count up" from zero and will also indicate ***elapsed run time***. The hold mode may be entered during a timed run.
If the hold mode is not desired, simply enter in a different time then the **HOL** display disappears.
If the run is stopped manually by pressing the **Stop/Open** switch the actual display will stop counting but will not be blanked even after reaching zero speed.
In the **timed mode** periods of from one second up to a total of 99 minutes 59 seconds are selectable in one-second increments. In this mode actual time displayed indicates a "count down" from set time to zero and will indicate ***remaining run time***. When the actual time display reaches zero it will be blanked.

Note that all "seconds" entries are forced to be less than 60.

The time may be reset during a run. The actual display will be "counting down" from the new value as soon as it is entered.
During a $\int w^2 dt$ run it is possible to change the set value of the $\int w^2 dt$ by pressing the **Time** / $\int w^2 dt$ switch. However, resetting the set-value will not affect the total accumulated $\int w^2 dt$. This means that the new set-value should be higher than the actual accumulated $\int w^2 dt$, or the machine will shut down.
It is possible to place the machine into the hold (untimed) mode with the $\int w^2 dt$ operation by entering a value of **00.: 00** for the set $\int w^2 dt$. If

operated in this condition the actual display will start at **0.0 : 00** and accumulate upwards until the machine is stopped manually.
The user can check and display elapsed time during a $\int w^2 dt$ run by pressing the **Time**/$\int w^2 dt$ switch twice in a row to change to an elapsed time display.
During operation in the $\int w^2 dt$ mode with an elapsed time display the set-value indicator will show **-.- : - -** to indicate that the run will still be ended by an $\int w^2 dt$ setting. Pressing the **Time** /$\int w^2 dt$ switch again will cause the normal $\int w^2 dt$ displays to return. If at the end of a run in the $\int w^2 dt$ mode the display was left showing elapsed time then the actual display will automatically change back to the total accumulated $w^2 dt$ mode when braking begins.
Note. If the hold mode Is selected the set-value indicator will still display **HOL**. No change of display mode during a run should affect either the total accumulated $w^2 dt$ or the total elapsed time since the start of the run.

17. Set **Time (Min/Sec)**/$\int w^2 dt$ **(Mant/Exp)** Indicator.

These green LED indicators display minutes and seconds in the **Time** mode and mantissa and exponent in the $\int w^2 dt$ mode.
Note that all entries in the $\int w^2 dt$ mode are in scientific notation. During operation in this mode the actual display will start at **0.0 : 00** and accumulate upwards toward the set value. When the set value is reached the machine will start braking but will continue to accumulate and display $\int w^2 dt$. When the machine reaches zero speed the actual $\int w^2 dt$ display will continue to display the accumulated $\int w^2 dt$.
Note. You **cannot** change the run duration mode from **Time** to $\int w^2 dt$, or vice versa, once the run has started. ***Only*** the display mode can be changed. When in the hold (untimed) mode; **HOL** will appear on the display.

18. Actual **Time**/$\int w^2 dt$ Indicator.

These red LED indicators show the actual run numbers: either; a timed, or an $\int w^2 dt$ run-cycle. These indicators display minutes and seconds in the **Time** mode and mantissa and exponent in the $\int w^2 dt$ mode.

19. Time Mode Indicator.

This green LED indicator is used to show that the machine is in the **Time** Mode.

20. $\int w^2 dt$ Mode Indicator.

This green LED indicator is used to indicate that the machine is in the $\int w^2 dt$ Mode.

21. Acceleration Rate Switch.

This switch is used with the numeric and **ENTER** keypad to select and display on the associated indicator, any of the ten, from zero **0** (slow) through **9** (maximum) acceleration rate profiles of operation. The switch settings provide an adjustable "soft" start acceleration rate from 0 to 250 rpm. At 250 rpm the rotor will accelerate at the maximum rate to the set speed. Refer to Figure 3-1A.

22. Acceleration Rate Indicator.

This green LED indicator displays the selected acceleration rate **0** (slow) through **9** (maximum). Values shown in this indicator effect acceleration rates below 250 rpm.

23. Brake (Deceleration Rate) Switch.

This switch is used with the numeric and **ENTER** keypad to select either a "coasting" mode, or, a braking mode of ending the run cycle. In the coasting mode (**0** position) you do not have a braking force applied to the drive motor so that the rotor is allowed to gently decelerate, or "coast," freely to a stop. In the braking mode a rotor-braking force is applied to the drive motor so that the rotor deceleration rate is controlled.

At brake positions **1, 2, 3, 4, 5, 6, 7, 8,** or **9**, rotor-braking force is automatically applied as shown in Figure 3-1A.

NOTE

The length of the coasting, and the braking, period depends on the rotor and load used, as well as, the speed of rotation just prior to stopping the run.

The deceleration rate may be increased or decreased at any point during a run.

Braking if pre-selected, will automatically be initiated at the end of the run cycle.

24. Brake (Deceleration Rate) Indicator.

This green LED indicator displays the selected deceleration rate (1 through 9) or the coast **0** setting.

25. Program Select Switch.

This switch is used with the numeric and **ENTER** keypad to select a preprogrammed run cycle.
This switch is active only when the key switch is at the **Pgm Set** or **Pgm Run** setting.

Switch Position	Brake Force	Speed
1	low	from set speed to stop.
2	maximum low	from set speed to 1900 rpm, and from 1900 to stop.
3	medium	from set speed to stop.
4	maximum low	from set speed to 1400 rpm, and from 1400 rpm to stop.
5	high	from set speed to stop.
6	maximum medium	from set speed to 1000 rpm, and from 1000 rpm to stop.
7	maximum medium	from set speed to 700 rpm, and from 700 rpm to stop.
8	maximum medium	from set speed to 400 rpm, and from 400 rpm to stop.
9	maximum	from set speed to stop.

An example of the braking rates is shown in the following graph:

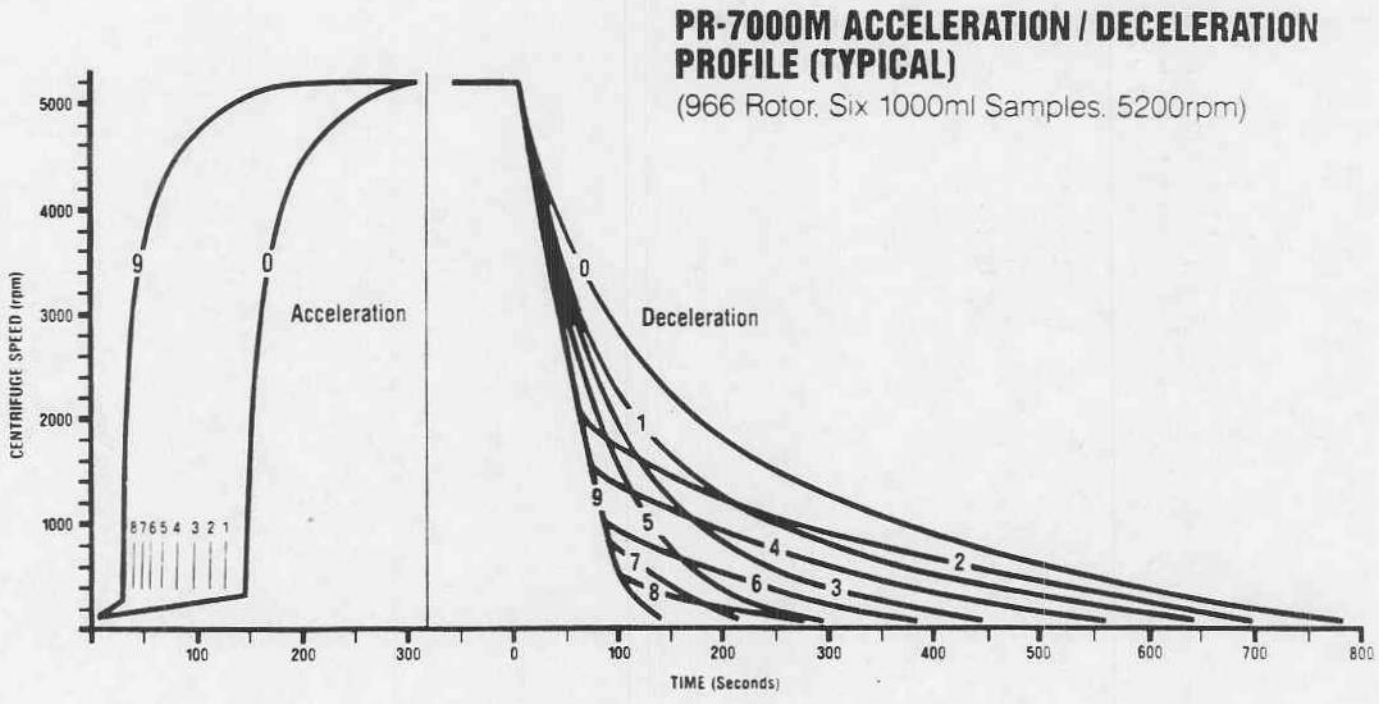


Figure 3-1A Acceleration / Deceleration Profile (Typical)

26. **Program** Indicator.

This green LED indicator displays the selected run cycle program. This indicator is active only when the key switch is at the **Pgm Set** or **Pgm Run** setting.

27. **Start**-Run Switch/Indicator.

This pushbutton switch/indicator is used to start the run if the centrifuge cover is closed and latched. When the switch is pushed, the green indicator in it will glow, and remain glowing, until the run ends.**The switch is also used to facilitate "repeat runs".**

NOTE

The centrifuge cannot be started until the cover is closed and latched.

If power to the centrifuge is interrupted the run will automatically be ended to prevent inadvertent startup when power is restored. When power is restored and the rotor is at rest the Start button must be pushed again to restart the run.

28. Diagnostic (**LATCH / IMBALANCE / OVERTEMP / BRUSHES**) Indicators.

One, or, more, of the following, yellow LED diagnostic messages may be displayed:

LATCH - The centrifuge cover is open or is not completely closed and latched;

IMBALANCE - The run has been terminated because of an imbalanced load in the rotor;

OVERTEMP - There is a refrigeration failure, or sample over temperature shutdown.

BRUSHES - There remains ***only*** About 20 hours of brush life. **CAUTION: Although the centrifuge may be operated with this brush-wear indicator still glowing, the brushes *MUST be replaced as soon as possible* to prevent damage to the motor commutator.**

NOTE. In addition to the above diagnostic messages the following error messages may appear in (10) the Rotor No. Indicator.

E00 Sample Temperature Alarm

This machine starts checking the temperature five minutes after either the **START** switch was pressed or the temperature set-point was changed. The actual temperature must be within ±7 °C of the set-point or the alarm will trip. If the alarm trips during operation the machine will shutdown and go into the maximum brake mode to stop; the **OVERTEMP** indicator will be displayed and the **Rotor No** indicator will show **E00**. After a sample over-temperature shutdown occurs you can restart the machine and clear the error by pressing the **START** switch.

E01 Power Board Fail

This error is caused when the power board senses uncontrolled high (greater than 19 amps for 10 milliseconds) currents applied to the motor. This is an indication that the power board power devices have failed. When this error occurs the machine will coast to a stop and restart should not be attempted. Call service personnel for a check of the power board.

E02 Tach Fail

This error is caused when the machine is in the run state and the measured RPM is equal to zero. When this error occurs the machine will immediately stop and go into a full-brake mode for four minutes. During this period you are not allowed to open the machine cover since rotation is assumed. After the four-minute interval you can open the cover but you cannot start the machine. Call service personnel for a check of the TACH sensor, TACH sensor connections and the Pulse Width Modulation (PWM) board.

E03 Motor Current Sense Fail

This error is caused when the machine senses the Power board is in current limit, however the measured value for current is less than 1 amp or when the PWM is greater than 75% and the measured current is less than one Ampere. When this error occurs the machine will coast to a stop. Once the machine has fully stopped you can open the cover but you cannot start the machine. Call service personnel for a check of the Power board, the Power board to PWM board connections and the PWM board.

E04 No Rotor Fail

This error indicates that the machine was started with no rotor installed. The error occurs when the RPM increases by more than 25 RPM within 1/2 second of operation. Note that this error will cause the machine to shutdown and coast to a stop and that the error can be cleared by opening the cover and installing a rotor.

E05 Board Communications Fail

This error indicates that the front panel micro-

processor has not successfully communicated with PWM microprocessor in the last two seconds. This error could be displayed as a result of the PWM board failure or faulty connection between the PWM board and the front panel microprocessor. Call service personnel for a check of the watchdog LED on the PWM board and of connections between the PWM and the front panel Logic board as well as on the two boards.

E06 Overspeed Fail

If during operation the measured rotor speed exceeds the maximum rated speed for the rotor entered into the **Rotor No** display by more than 5% then an overspeed shutdown will occur.

E07 Guard Bowl Over Temp

This error indicates that the guard bowl temperature has exceeded it's safe operating temperature. When this error is displayed the machine will shutdown and brake to a stop and restart is not possible until the guard bowl cools to within it's safe operating temperature. This error usually indicates that the refrigeration system has failed. Call service personnel for a check of the refrigeration system.

E08 Nonvolatile RAM Failure

This error indicates a failure of the memory storage used to retain the machine set-up information when the machine power is off. This error will not allow the machine to operate. Call service personnel for a check of the RAM.

29. Cover Safety-Latch-Interlock Bypass Access.

This centrifuge protects the user by locking the centrifuge cover closed during the run cycle. This safety feature may be bypassed for servicing or, for removing a sample in case of a power failure.

WARNING

WAIT AT LEAST TWENTY MINUTES AFTER A LOSS OF POWER BEFORE ATTEMPTING TO BYPASS THE SAFETY INTERLOCK. THE MACHINE POWER CORD MUST BE UNPLUGGED. DO NOT BYPASS THE COVER SAFETY INTERLOCK AS A ROUTINE OPERATION BECAUSE OF DANGER TO THE USER.

3.2.2 Dataplate/Power-Cord.

A dataplate which specifies the serial number, power requirements, and other pertinent information is located on the lower-left corner of the centrifuge.

A three - conductor, six - foot (1.8 meters) long power line cord is also located on the base assembly of the centrifuge.

The cord is used to connect the centrifuge to an AC power outlet. Consult the dataplate, and paragraph 2.4, for the correct electrical power requirements and power connections.

3.3 Operational Precautions

CAUTIONS

1. DO NOT ATTEMPT TO OPERATE THIS CENTRIFUGE BEFORE READING THIS SECTION OF THE MANUAL.

2. FOR PROPER OPERATION AND ASSURANCE OF GOOD SEPARATION, ROTOR LOADS *MUST* BE BALANCED IN ACCORDANCE WITH PARAGRAPH 3.4.3. IF YOU OPERATE THE ROTOR WITH *LESS* THAN A FULL COMPLEMENT OF TUBES BE SURE TO BALANCE THE OPPOSITE-LOAD TUBES IN PAIRS, OR, AS DESCRIBED.

3. DO NOT USE OTHER MANUFACTURERS' ACCESSORIES IN IEC CENTRIFUGES UNLESS THEY ARE SPECIFIED IN THIS MANUAL. SUCH MISUSE OF IEC PRODUCTS IS POTENTIALLY DANGEROUS AND WILL VOID THE WARRANTY.

4. DO NOT ADJUST ANY INTERNAL CONTROLS.

5. DO NOT BLOCK THE FRONT LOUVER OR THE REAR VENT OR GRILLE OF THE CENTRIFUGE, OTHERWISE, AIR FLOW WILL BE REDUCED RESULTING IN POOR COOLING AND EARLY FAILURE OF INTERNAL COMPONENTS. ALLOW 4.0 IN.(10.2CM) OF FREE SPACE AT THE REAR, OF THE CENTRIFUGE. DO NOT PLACE THE CENTRIFUGE AGAINST RADIATORS OR OTHER HEATING ELEMENTS.

6. *NEVER* RUN THE CENTRIFUGE WITHOUT THE ROTOR INSTALLED. OTHERWISE, THE SHAFT MAY BE DAMAGED.

7. TURN THE POWER OFF WHEN THE CENTRIFUGE IS NOT IN USE FOR LONG PERIODS TO SAVE ENERGY.

8. DO NOT LEAVE LIT CIGARETTES OR OTHER SMOKING MATERIALS ON TOP OF THE CENTRIFUGE AS THEY WILL LEAVE UNREMOVABLE MARKS.

9. IF TUBE BREAKAGE OCCURS WITH INFECTIOUS OR RADIOACTIVE MATERIALS THE CENTRIFUGE AND ALL ITS COMPONENTS MUST BE STERILIZED OR DECONTAMINATED.

10. THIS IEC CENTRIFUGE IS NOT SUITABLE FOR USE IN HAZARDOUS LOCATIONS. IT IS UNSAFE TO PLACE VOLATILE COMBUSTIBLES IN OR NEAR THE CENTRIFUGE.

11. CLEAN THE CENTRIFUGE CHAMBER AND THE OUTSIDE OF THE CENTRIFUGE WITH A DAMP, NOT WET, SPONGE. USE A MILD DETERGENT AND WARM WATER SOLUTION TO DAMPEN THE SPONGE. *NEVER* POUR SOLUTIONS INTO THE CHAMBER. DO NOT USE A SOLVENT-BASED CLEANER.

12. DO NOT OPERATE THE 966 ROTOR ABOVE 5600 RPM AS STRUCTURAL DAMAGE TO THE ROTOR WILL OCCUR.

WARNINGS

1. THIS CENTRIFUGE MUST BE SECURELY MOUNTED TO THE FLOOR AS DESCRIBED IN SECTION TWO INSTALLATION.

2. TO AVOID AN ELECTRICAL SHOCK, THE POWER CORD *MUST* BE PLUGGED INTO A GROUNDED OUTLET, *NEVER* REMOVE THE GROUNDING PRONG FROM THE POWER PLUG OR USE ANY ADAPTER WHICH DEFEATS, OR THAT DOES NOT COMPLETE, THE POWER GROUND CIRCUIT.

3. *ALWAYS* UNPLUG THE POWER CORD BEFORE REMOVING THE FRONT LOUVER, THE REAR PANEL, OR THE REAR GRILLE OF THE CENTRIFUGE, AS THIS EXPOSES ELECTRICAL SHOCK AREAS WHERE POTENTIALLY LETHAL VOLTAGES ARE PRESENT.

4. DO NOT OPERATE THIS CENTRIFUGE IF THE ROTOR OR ACCESSORIES SHOW SIGNS OF DETERIORATION OR CORROSION IF DETERIORATION OR CORROSION IS VISIBLE, STOP USING AND REPLACE THE ITEM(S) IMMEDIATELY.

5. REFER TO PARAGRAPH 3.4.2 AND TO FIGURE 3-2 FOR THE CORRECT ROTOR INSTALLATION PROCEDURE.

6. TO PREVENT CORROSION, NEVER USE SODIUM HYPOCHLORIDE (HOUSEHOLD BLEACH) AS A STERILIZING AGENT FOR ALUMINUM, MAGNESIUM, OR MAGNESIUM BRONZE ROTORS OR ACCESSORIES.

7. *NEVER* ATTEMPT TO OVERRIDE THE COVER INTERLOCK UNDER NORMAL OPERATING CONDITIONS. WAIT AT LEAST *TWENTY MINUTES* AFTER A LOSS OF POWER AND AFTER THE ROTOR STOPS SPINNING *BEFORE* OVERRIDING THE INTERLOCK.

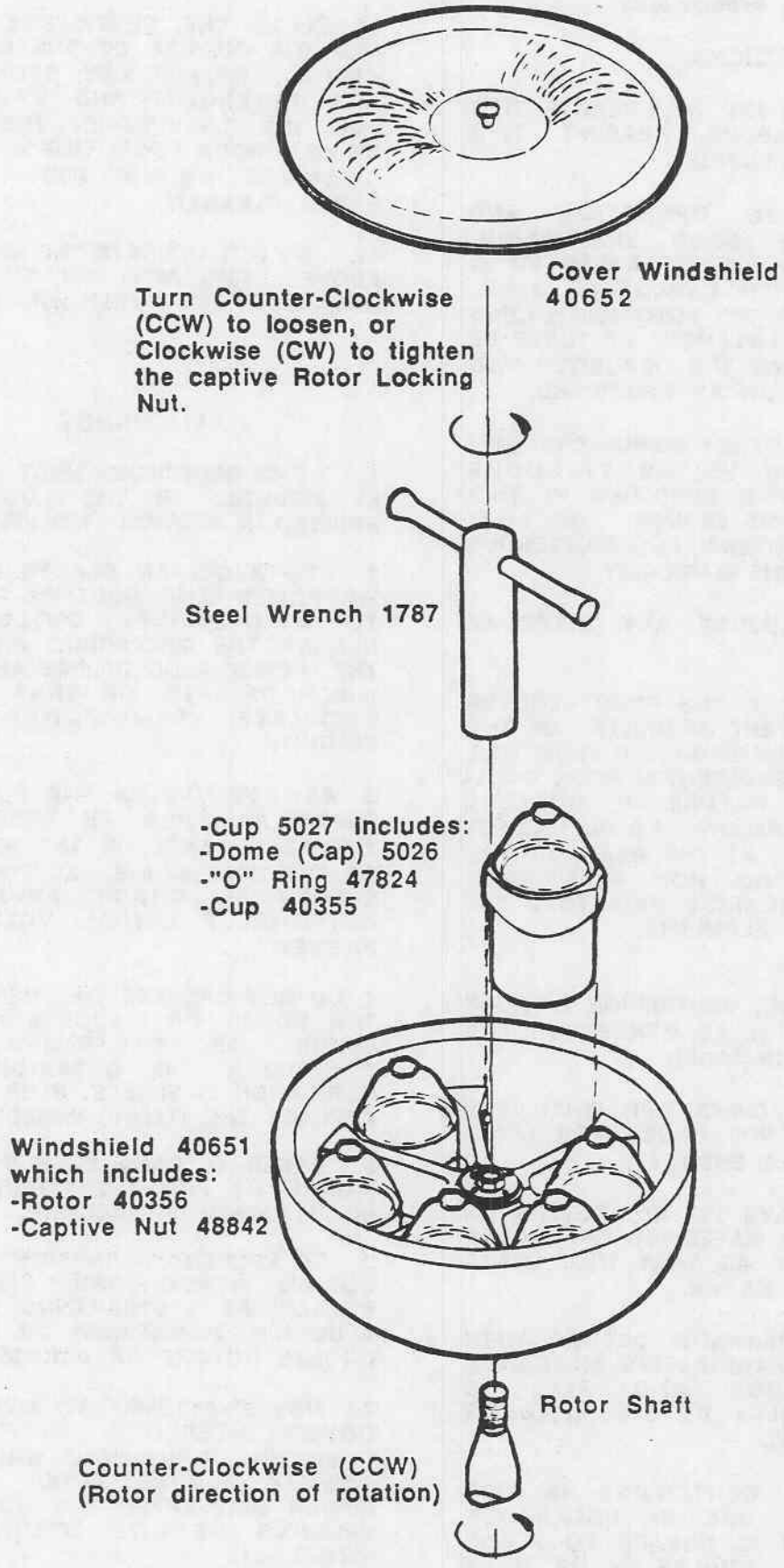


Figure 3-2 966 Rotor Assembly

3.4 Operating Procedure

Centrifuge operation normally involves; applying power, selecting the program mode, opening the cover, installing a rotor with balanced accessories and a balanced load in the rotor, selecting the chamber operating temperature, acceleration rate, braking, speed/RCF and duration of the run (time / $\int w^2 dt$) cycle, closing the cover, starting the run cycle, stopping the run cycle, (the run cycle ends automatically at the end of a programmed timed or $\int w^2 dt$ run), opening the cover and removing the rotor.

The following paragraphs describe the operation.

3.4.1 Opening the Cover

1. Push the **Power** switch button to the **ON/1** position. The actual guardbowl temperature will be displayed. The red **STOP/OPEN** indicator will glow.

2. Push the **STOP/OPEN** button. The cover interlock will be activated and it will release the latch. The counter-balanced cover will open. The word **LATCH** will appear in yellow on the display.

NOTE

If there is a power failure, or other emergency, the cover interlock may be released as described in paragraph 3.8.

WARNING

IF, AT THE TIME OF A POWER FAILURE, THE ROTOR IS STILL SPINNING *WAIT* AT LEAST TWENTY MINUTES *BEFORE* ATTEMPTING TO OPEN THE COVER AS DESCRIBED IN PAR. 3.8.

3.4.2 Installing the Rotor

Table 3-1 is used for computing the relative centrifugal force (RCF) at radii and speeds not listed in Table 3-3. Table 3-2 shows tube information. Table 3-3 shows the maximum rated speed for the particular rotor and accessories. Table 3-4 shows the derating factors versus specific gravity of rotor contents. Table 3-5 shows the chemical resistance of IEC plastics.

CAUTION

IT IS ESSENTIAL THAT *ONLY* IEC ROTORS THAT ARE REFERENCED IN TABLE 3-3 AND THEIR ACCESSORIES BE USED IN THIS CENTRIFUGE. USE OF OTHER ROTORS AND ACCESSORIES IS DANGEROUS AND WILL VOID THE WARRANTY.

1. Check that the drive shaft and the rotor-shaft hole are clean.

2. Remove all materials from inside the chamber.

3. Remove the windshielded rotor cover by lifting it straight up and off the rotor. Remove the cups.

4. Install a properly balanced 966 rotor as follows:

***Always* install the rotor in the chamber without accessories (cups, carriers, shields and/or trunnion rings, cushions, glassware, or plasticware, etc.). Then add a full complement of accessories as needed. Also, check that each shield has the proper cushion and that *all* shields contain one cushion.**
Insert the rotor through the guard bowl opening with care.

- Install the rotor onto the shaft. Make sure the rotor is fully seated on the shaft.

NOTE

After placing the 966 Windshielded rotor on the shaft it may be necessary to take the weight off the rotor, by lifting it up slightly with one hand, while turning the nut down on the shaft with the other hand, to engage (resistance will be felt) the threads of the tapered shaft. Turn the locking nut, when resistance is no longer felt then the rotor is seated. Release the rotor. Now use the 1787 wrench to tighten the rotor nut securely.

- Turn the captive rotor locking nut down onto the shaft threads. Use the wrench, IEC part no. 1787, to tighten the nut down on the shaft.

3.4.3 Loading and Balancing the Rotor

CAUTION

ROTOR BALANCE *MUST* BE MAINTAINED.
All centrifuges have "critical speeds" at which vibration occurs. As the speed increases beyond the critical speed vibrations will cease. This inherent condition also occurs during deceleration. An *imbalanced* load intensifies these critical frequencies. Critical speeds do not occur in the operating (1000-6900 rpm) range of the PR-7000M. However, excessive vibration of the instrument during normal laboratory use may be directly traceable to rotor imbalance.

Ensure that the rotor is loaded symmetrically and with a full (or paired) complement of tubes and/or carriers with opposite loads weighing within 0.5 grams of each other.

WARNING

***NEVER* USE MERCURY FOR BALANCING OR FOR ANY OTHER PURPOSE. WHEN CENTRIFUGED MERCURY VAPORIZES. MERCURY VAPORS ARE *HIGHLY TOXIC* AND THEY REACT WITH ALUMINUM.**

Accessory balance is also an important factor in prolonging the life of the armature and bearings of the centrifuge motor. IEC rotors as well as all rotating parts of the centrifuge, are dynamically balanced at the factory. In addition, IEC trunnion rings, shields, cups and carriers are weighed and matched to 0.5 grams. The gram weight is stamped on each piece.

All horizontal rotors must be loaded with a full complement of accessories to prevent unequal stresses on the rotor during operation.

To obtain good dynamic balance the opposite loads must not only be equal in mass, but must also have the same center of gravity. Take care to select centrifuge tubes and bottles in pairs which are alike in shape, thickness, and distribution of glass or plastic. The larger the container, the more critical the selection should be. When measuring weight, use a laboratory balance having a sufficient capacity to handle the size container being used, and which has a sensitivity of one-tenth of a gram at full load.

1. Place the required accessories and tubes in the rotor. If less than a full complement of tubes are to be used, be sure to balance the tubes in pairs. In most rotors and adapters certain tube holes are numbered to facilitate pairing and sample identification.

2. Close the cover firmly to latch and to lock it. The word **LATCH** will disappear from the display.

3.4.4 Programming the Run Cycle

WARNING

***NEVER* ATTEMPT TO OPEN THE COVER WHILE THE ROTOR IS SPINNING.**

1. Set the operating mode key switch to the **manual** position.

2. Use the **Rotor No.** switch and the numeric and **ENTER** keypad to enter the installed rotor number as follows:
- Press the **Rotor No.** switch. The selected rotor number will be replaced by - - - - for a few seconds.
- Press the rotor number on the numeric keys of the **ENTER** keypad.
- Press the **ENTER** key on the **ENTER** keypad.

The maximum rotor radius (see Table 3-6) will be automatically entered for the rotor number entered.

Note. If a different-than-maximum rotor radius is desired, enter it now before the run begins because you **cannot** change it during a run. Any radius between a minimum of 6.0 cm and a maximum of 27.5 cm may be entered. Any out-of-range entry will cause an **EE . E** display and the machine will not run until a valid number is entered. To enter the radius:
- Press the **Rotor No.** switch twice to view the radius and once again to change this radius. The selected rotor number will be replaced by - - - - for a few seconds.
- Press the appropriate numeric keys on the **ENTER** keypad.
- Press the **ENTER** key on the **ENTER** keypad.

Note. The modified radius will remain in effect as long as the rotor number is not changed. If the number is changed the radius will revert to the one assigned for that rotor. **Note** During operation you cannot change rotor number or radius, however, if the **Rotor No.** switch is pressed the indicator will alternately display the rotor number and the rotor radius.

3. Use the **Temp C°** switch and the numeric and **ENTER** keypad to select the desired temperature as follows:
- Press the **Temp C°** switch.
- Press the appropriate numeric keys (and the " - " sign for a minus temperature) on the **ENTER** keypad.
- Press the **ENTER** key on the **ENTER** keypad.

4. Use the **Accel** switch and the numeric and **ENTER** keypad to select the desired acceleration rate as follows:
- Press the **Accel** switch.
- Press the appropriate numeric keys on the **ENTER** keypad.
- Press the **ENTER** key on the **ENTER** keypad.

5. Use the **Brake** switch and the numeric and **ENTER** keypad to select the desired deceleration rate as follows:
- Press the **Brake** switch.
- Press the appropriate numeric keys on the **ENTER** keypad.
- Press the **ENTER** key on the **ENTER** keypad.

6. Use the **RPM/RCF** switch and the numeric and **ENTER** keypad to select the desired speed RPM or RCF as follows:
- Press the **RPM/RCF** switch for an RPM or an RCF mode.
- Press the appropriate numeric keys on the **ENTER** keypad.
- Press the **ENTER** key on the **ENTER** keypad.

7. Use the **Time / $\int w^2 dt$** Switch and the numeric and **ENTER** keypad to select: an untimed (Hold); a timed, or, an $\int w^2 dt$ run-cycle run.

To select an untimed (hold) run:

- Press **Time / $\int w^2 dt$** switch to the **Time** mode.

- Press the **0** key on the numeric keypad.
- Press the **ENTER** key on the **ENTER** keypad.

The word **HOL** will appear on the display.

To select a run in the $\int w^2dt$ mode.

- Press the **Time / $\int w^2dt$** switch. The display will be replaced by **- - : - -** for a few seconds.
- Press the **Time / $\int w^2dt$** switch again. The display will be replaced by **- .- : - -** for a few seconds and the green **$\int w^2dt$** indicator will glow.
- Press the appropriate numeric keys on the numeric keypad.
- Press the **ENTER** key on the **ENTER** keypad.

To select an untimed (hold) run in the $\int w^2dt$ mode.

- Press the **Time /$\int w^2dt$** switch to the **$\int w^2dt$** mode.
- Enter **00 : 00** for the set **$\int w^2dt$** .
- Press the **ENTER** key on the **ENTER** keypad.

If operated in this condition the actual display will start at **0.0 : 00** and accumulate upwards until the machine is stopped manually.

To select a timed run:

Use the **Time /$\int w^2dt$** switch and the numeric and **ENTER** keypad to select the desired run time as follows:
- Press the **Time /$\int w^2dt$** switch to the **Time** or the **$\int w^2dt$** mode.
- Press the appropriate numeric keys on the numeric keypad for the desired run time in minutes and seconds.
- Press the **ENTER** key on the **ENTER** keypad.

To set or modify a programmed run:

Note. *Ten programs may be stored, and modified, as follows:*
To set a run ;
- Turn the Operating Mode Locking key to the **Pgm Set** position.
- Use the **Program** switch to assign a 0 - 9 program number.
- Press the **ENTER** key.
- Enter the run parameters as outlined above. Repeat this procedure for up to ten programs.

To modify a run ;
- Turn the Operating Mode Locking key to the **Pgm Set** position.
- Use the **Program** switch to assign a 0 - 9 program number.
- Press the **ENTER** key.
- Enter the new run parameters as outlined above.

3.4.5 Starting the Run Cycle

1. Push the **Start** button. Its green indicator will glow. The red **STOP/OPEN** indicator will stop glowing.

- The rotor will start to accelerate.

NOTE

The acceleration will be ***normal*** at any speed above **250** rpm ***regardless*** of the **Accel** switch setting.

- The rotor will accelerate to, and maintain, the set speed.

The normal direction of rotation of the rotor during a run is counter-clockwise (CCW) as viewed from above.

NOTE. It takes one-to-two minutes (after the acceleration period) for the speed to stabilize to ±10 rpm of the set speed

2. The timer (if entered) will be operational.

3. When the run ends, the green **Start** button indicator will stop glowing and the rotor will start to decelerate.

The red **STOP/OPEN** indicator will glow when the rotor is at **0** rpm.

4. Push the **STOP/OPEN** button. The cover will open. The red **STOP/OPEN** button indicator will remain glowing and a yellow **LATCH** will appear on the display.

5. Push the **Power** button to the **OFF/0** position. All the indicators will stop glowing.

3.4.6 Changing Modes During Run

Changing run-cycle temperature-

- Use the Set **Temperature C°** switch and the numeric and **ENTER** keypad to **increase**, or **decrease** the chamber temperature. Note: If the change is more than ± 7 degrees and the new set temperature is not achieved within ten minutes the machine will shut down with a sample temperature fail **E . 00** and **O-TEMP** diagnostic display.

Changing run-cycle period-

- Use the **Time** switch and the numeric and **ENTER** keypad to **increase**, or **decrease** the run-cycle period as follows:
- Press the **Time** switch.
- Press the appropriate numeric keys on the **ENTER** keypad.
- Press the **ENTER** key on the **ENTER** keypad.
- Push the **Start** switch again.

Changing run-cycle speed-

- Use the **RPM/RCF** switch and the numeric and **ENTER** keypad to **increase**, or **decrease** the run-cycle speed or RCF as follows:
- Press the **RPM/RCF** switch.

- Press the appropriate numeric keys on the numeric keypad.
- Press the **ENTER** key on the **ENTER** keypad.

Changing run-cycle from RPM to RCF mode-

- Use the **RPM/RCF** switch and the numeric and **ENTER** keypad to change from the run-cycle speed RPM mode to the RCF mode as follows:
- Press the **RPM/RCF** switch twice to change modes with an equivalent set point.
- Press the **RPM/RCF** switch again and press the appropriate numeric keys on the **ENTER** keypad.
- Press the **ENTER** key on the **ENTER** keypad.
- Select the desired progam.

3.4.7 Stopping the Run Cycle

When in the timed mode, the run will automatically end, and the rotor will start to decelerate, when the selected period has elapsed.

To end the run manually when in the untimed mode or anytime; press the **Stop/ Open** button.
The run cannot be restarted until the rotor is ***completely stopped***.

3.4.8 Opening the Cover

1. When the rotor is at rest the **Stop/Open Cover** indicator will glow showing that the cover may be opened.

2. Press the **Open Cover** button. The cover interlock will release. The cover will open.

3. Remove the sample tubes.

3.4.9 Removing the Rotor

If the rotor is to be used again leave it in the chamber and simply remove the load accessories. However, if desired remove the rotor as follows:

1. Remove the windshielded rotor cover by lifting it straight up and off the rotor. Remove the load accessories.

2. Use the IEC part no. 1787 wrench to loosen the captive rotor-locking nut on the threaded rotor shaft in the chamber.

NOTE

When removing the 966 rotor:

- Remove the cups first.

- Unscrew the rotor locking nut with the 1787 wrench until the rotor "pops" up and then becomes free of the tapered shaft. Then take the weight off the rotor by lifting it up slightly with one hand, while using the 1787 wrench to turn the nut up on the shaft with the other hand, to disengage (resistance will be felt) the threads of the tapered shaft.

- Loosen the captive rotor nut completely.

3. Remove the rotor by lifting it carefully out of the chamber. Take care not to damage the shaft screw threads.

4. Clean up any spills immediately after the run to prevent rust and corrosion which could damage, and make the rotor, accessories and the centrifuge itself, unfit for use.

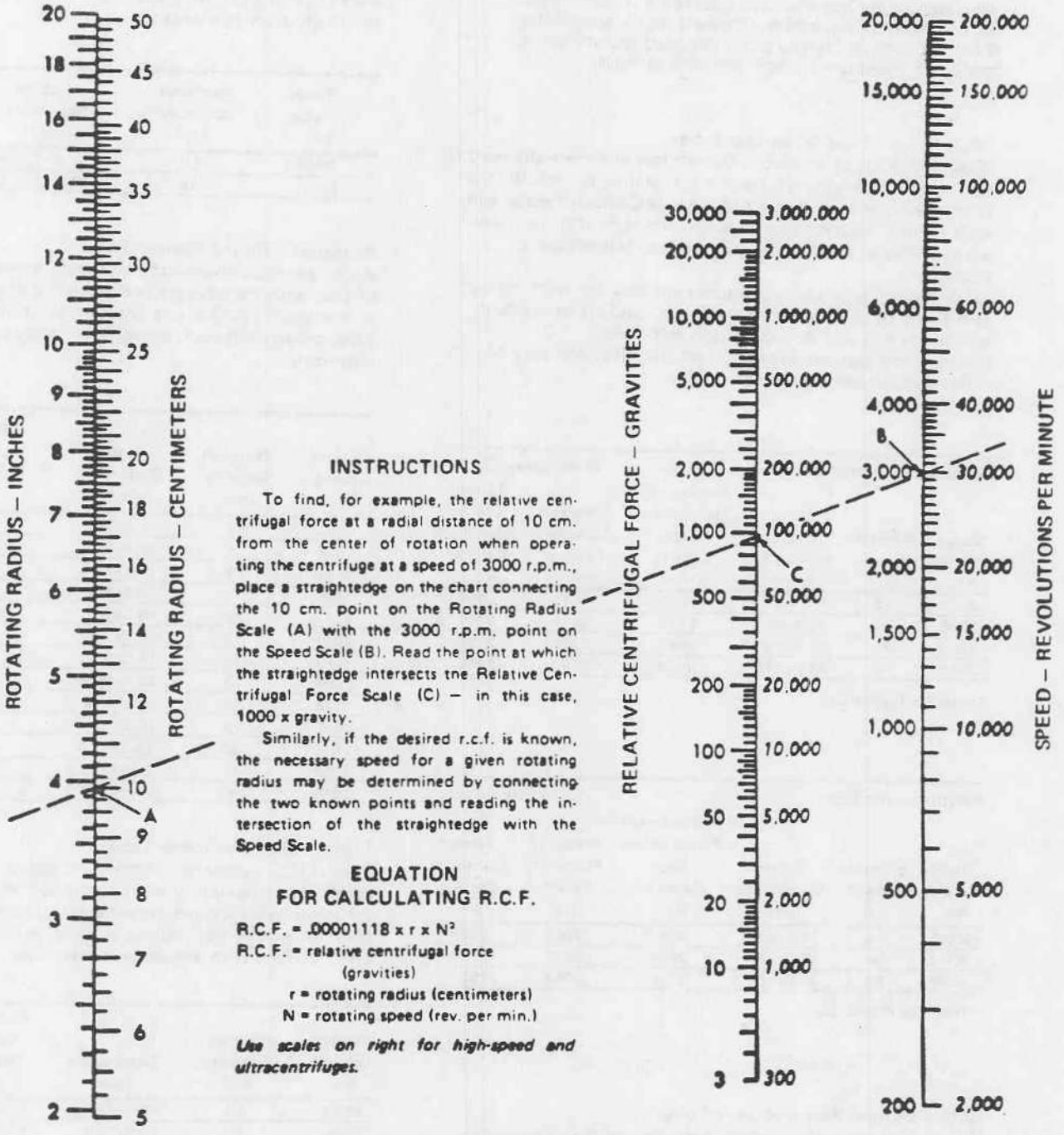

ROTATING RADIUS – INCHES
ROTATING RADIUS – CENTIMETERS
RELATIVE CENTRIFUGAL FORCE – GRAVITIES
SPEED – REVOLUTIONS PER MINUTE
A
B
C
INSTRUCTIONS
To find, for example, the relative centrifugal force at a radial distance of 10 cm. from the center of rotation when operating the centrifuge at a speed of 3000 r.p.m., place a straightedge on the chart connecting the 10 cm. point on the Rotating Radius Scale (A) with the 3000 r.p.m. point on the Speed Scale (B). Read the point at which the straightedge intersects the Relative Centrifugal Force Scale (C) – in this case, 1000 x gravity.
Similarly, if the desired r.c.f. is known, the necessary speed for a given rotating radius may be determined by connecting the two known points and reading the intersection of the straightedge with the Speed Scale.
EQUATION FOR CALCULATING R.C.F.
R.C.F. = .00001118 x r x N²
R.C.F. = relative centrifugal force (gravities)
r = rotating radius (centimeters)
N = rotating speed (rev. per min.)
Use scales on right for high-speed and ultracentrifuges.

Table 3-1 Relative Centrifugal Force (RCF) Nomograph

Table 3-2 IEC Centritube™ Table

IEC Centritubes

Centritubes are manufactured specifically for centrifugation to International Equipment Company (IEC) specifications. Each IEC tube, bottle and cap is designed and molded for perfect fit, maximum strength and wide versatility.

"Oak Ridge" Type Screw Cap Tubes

"Oak Ridge" type screw-cap Centritubes eliminate the need for costly, time-consuming 5-piece metal sealing sytems. With a simple twist of the wrist, a one-piece IEC knurled metal cap seals tightly, assuring a positive vacuum tight seal. The caps are available in anodized aluminium and teflon coated aluminium.

"Oak Ridge" type screw cap tubes are ideal for working with virological or other infectious material, and are available in polypropylene and Autoclear polycarbonate.

Plastic screw caps are supplied with the tubes and may be safely used in low speed centrifuges.

Autoclear Polycarbonate Tubes			Metal Screw Caps		
Tubes Catalog No.	Nominal Capacity (ml)	Outside* Dimensions (mm)	Replacement Plastic Screw Caps Catalog No.	Anodized Aluminum Catalog No.	Teflon Coated Aluminum Catalog No.
2067	10	16.1x81.4	2887	2066	2064
2055	30	25.3x93	2886	2056	2057
2053	50	28.6x106.1	2888	2063	2054
2059	73	38.1x110.2	2889	2060	2058

*Includes Plastic Cap

Polypropylene Tubes			Metal Screw Caps		
Tubes Catalog No.	Nominal Capacity (ml)	Outside* Dimensions (mm)	Replacement Plastic Screw Caps Catalog No.	Anodized Aluminum Catalog No.	Teflon Coated Aluminum Catalog No.
2046	10	16.1x81.4	2887	2066	2064
2047	30	25.3x93	2886	2056	2057
2048	50	28.6x106.1	2888	2063	2054

*Includes Plastic Cap

Round Bottom Polypropylene Tubes

IEC general purpose polypropylene Centritubes are molded from a special high strength resin which is the clearest of the translucent polypropylene plastics. All are autoclavable.

Tubes Catalog No.	Nominal Capacity (ml)	Outside Dimensions (mm)	Plastic Caps Catalog No.	Aluminum Sealing Caps Catalog No.
1629	13	16x98.3	1514	1578
1630	46	28.6x103.8	1518	1580

Autoclear Conical Graduated Tubes

Autoclear polycarbonate graduated tubes are ideal for clinical work requiring percise graduations and are molded under extremely close tolerances.

Tubes Catalog No.	Nominal Capacity (ml)	Outside Dimensions (mm)	Plastic Caps Catalog No.
2809	50	28.6x133.4	1518
2810	15	16.8x119.1	2884

Autoclear® Round Bottom Tubes

Autoclear round bottom tubes combine many of the advantages of glass with the strength and economy of plastic. Ideal for high or low speed applications, these crystal clear polycarbonate tubes are shatterproof, autoclavable and resistant to most chemicals.

Tubes Catalog No.	Nominal Capacity (ml)	Outside Dimensions (mm)	Plastic Caps Catalog No.	Aluminum Sealing Caps Catalog No.
2852	3	10.9x54.7		
2804	4	10.9x77.2	2880	
1696	8	16x60.3	2876	
1698	8.5	13x106.3	1699	
2816	10	14.5x96	1676	1586
2801	10	16.1x76.2	2877	1183
1649	12	16.0x98.7	1514	157
2808	12	20.4x60.4	1677	
1648	15	16x114.3	1514	1578
2805	22	18.7x111.1	2881	
2802	30	25.3x88.9	2878	1177
2997	47	28.6x103.8	1580	1580
2806	96	31.9x161.8	2882	

Transparent Polyallomer Tubes

Special IEC transparent thin-walled polyallomer tube combine the flexibility and capacity of cellulose nitrate with the autoclavability and chemical stability of polypropylene. Ideal for gradient or routine analysis, these tubes may be easily pierced with a hypodermic syringe.

Tubes Catalog No.	Nominal Capacity (ml)	Dimensions (mm)	Plastic Caps Catalog No.	Aluminum Sealing Caps Catalog No.
2841	3.5	10.9x54.7	1524	
2840	5	10.9x77.2	1524	
2860	9	16.1x57.9	2897	
2836	10	12.7x98.4		
2864	10	12.7x108		
2842	12	14.5x96	1514	
2850	12	16.1x76.2	2897	1181
2859	16	16.1x101.6	2897	
2858	17	16.1x108	2897	
2837	19	16.1x114.3	2897	
2839	28	26.2x66.8	2899	
2847	37	25.4x88.9		11
2828	52	28.6x103.7		

Table 3-3 Speed and Force Data

Rotor Cat.No.	Rotor Type	Tube No.	Tube Vol (ml)	rpm (Max)	RCF (Max)	Radius cm(Max)	Accessory Cat.No.
822A	45°Angle	12	50	6900	8300	15.6	Shield 305
825S	45°Angle	8	50	6900	7675	14.4	Shield 324
845A	45°Angle	8	240	6900	9635	18.1	----------
850S	45°Angle	6	250	6900	9325	17.5	Cup 2743S
219	*SBW	4	750	5000	5375	†19.2	Cup 5218
276	+SB	4	1000	3700	3600	†23.5	Cup 353S
966	*SBW	6	1000	5200	7400	†24.5	Cup 5027
259	+SB	6	350	3500	3350	†24.5	Cup 384S
949	+SB	6	1000	3400	3225	†25.7	Cup 403S
972	*SBW	6	Blood Bags	4600	5800	†24.5	Cup 5037

227 Linear Tube Tray Rotor

Instrument Manufacturer	Manufacturer's Rack No.	Racks per rotor	IEC Tray No.	Max No. of Tubes	rpm (Max)	RCF at Center Radius	RCF at Edge Radius
#	#	4 - 20	#	48 - 240	3300	2000	2600

Refer to the 227 Linear Tube Tray Instruction Manual, IM-207 for this information.

+ SB Swinging Bucket

* SBW Swinging Bucket Windshielded

† Inside bottom of cup

IMPORTANT

IEC ROTOR DERATING FACTORS vs. SPECIFIC GRAVITY OF ROTOR CONTENTS

All International Equipment Company horizontal and angle rotors are provided with an unlimited operational warranty, excluding mishandling, and never require derating due to hourly or cyclic use provided that corrosion is eliminated and rotor contents do not exceed maximum allowable specific gravity.

Maximum specific gravity permissable without derating is 1.2 in horizontal (swinging bucket rotors) and 1.5 in angle rotors. For specific gravities in excess of 1.2 in a horizontal rotor or 1.5 in an angle rotor, the published speed must be multiplied times the derating factor corresponding to the average specific gravity of the tube plus contents. RPM (allowable) = RPM (Maximum) x derating factor.

The chart below indicates the derating factor for specific gravities from 1.2 to 3.0 in specific gravity increments of .10.

	DERATING FACTOR (D.F.)	
SPECIFIC GRAVITY	HORIZONTAL ROTORS	ANGLE ROTORS
1.20	– – –	– – –
1.30	.960	– – –
1.40	.925	– – –
1.50	.894	– – –
1.60	.866	.967
1.70	.839	.939
1.80	.816	.912
1.90	.794	.888
2.00	.774	.866
2.10	.755	.844
2.20	.738	.825
2.30	.721	.807
2.40	.707	.790
2.50	.692	.774
2.60	.678	.758
2.70	.666	.744
2.80	.654	.731
2.90	.642	.719
3.00	.632	.707

This table is based on the formula:

$$D.F. = \sqrt{\frac{\text{Max. SP. GR. permissible without derating}}{\text{Actual SP. GR.}}}$$

and may be utilized to calculate derating factors for specific gravities greater than 3.0

RPM (allowable) = RPM (Maximum) x D.F.

Table 3-4 Derating factors

Table 3-5 Chemical Resistance of IEC Centrifuge Tubes and Bottles at 20°C

Chemical	PP	PE	PA	PC
Acetaldehyde	G	G	G	F
Acetic Acid (5%)	E	E	E	E
Acetic Acid (60%)	F	F	E	U
Acetic Acid (Glacial)	U	U	E	U
Acetic Anhydride	U	U	U	U
Acetone	G	G	G	U
Acetonitrile	F	E	F	U
Acrylonitrile	F	E	F	U
Adipic Acid	E	E	E	E
Alconox	E	E	E	F
Aluminum Chloride	E	E	E	E
Aluminum Hydroxide	E	E	E	F
Ammonia	E	E	E	U
Ammonia Acetate	E	E	E	E
Ammonium Carbonate	E	E	E	U
Ammonium Chloride	E	E	E	E
Ammonium Hydroxide (5%)	E	E	E	F
Ammonium Hydroxide (30%)	E	E	E	U
Ammonium Phosphate	E	E	E	E
Ammonium Sulfate	E	E	E	E
Amyl Acetate	G	E	G	U
Amyl Alcohol	F	G	F	E
Amyl Chloride	U	F	U	U
Aniline	G	U	U	U
Barium Salts	E	E	E	E
Benzaldehyde	E	E	E	F
Benzene	U	U	U	U
Benzoic Acid	E	E	E	E
Benzyl Alcohol	U	F	U	U
Boric Acid	E	E	E	E
Bromine	U	F	U	F
n-Butyl Acetate	E	E	E	F
n-Butyl Alcohol	G	F	G	G
Butyric Acid	U	F	U	F
Calcium Chloride	E	E	E	F
Calcium Hydroxide Conc	E	E	E	U
Calcium Hypochlorite Sat	E	E	E	F
Carbon Tetrachloride	U	U	U	U
Cesium Salts	E	E	E	E
Chlorine (Wet)	G	F	G	E
Chlorine (Dry)	G	F	G	E
Chlorobenzene	U	U	U	U
Chloroform	U	U	U	U
Chromic Acid (10%)	E	E	E	G
Chromic Acid (50%)	G	E	G	U
Citric Acid	E	E	E	E
Cresol	U	U	F	U
Cyclohexane	U	U	U	U
Cyclohexyl Alcohol	E	E	E	F
Decalin	G	E	G	U
Dextran or Dextran Sulfate	E	E	E	E
Diethyl Ketone	F	U	F	U
N, N-Dimethylformamide	E	E	E	U
Dimethylsulfoxide	E	E	E	U
Dioxane	F	U	F	U
Ethers	U	U	U	U
Ethanol (50%)	E	E	E	U
Ethanol (95%)	E	G	E	U
Ethyl Acetate	E	U	F	U
Ethylene Dichloride	U	U	F	U
Ethylene Glycol	E	E	E	U
Ethylene Oxide	E	E	E	F
Fatty Acids, Saturated	G	U	E	E
Fatty Acids, Unsaturated	G	U	E	E
Ficoll-Paque	E	E	E	E
Formaldehyde (40% Formalin)	E	E	E	E
Formic Acid	E	E	E	F
Gasoline	F	G	F	F
Glycerine (Glycerol)	E	E	E	E
Haemo-sol	E	E	E	E
Hexane	F	U	U	U
Hydrochloric Acid (30%)	E	E	E	U
Hydrochloric Acid (50%)	F	E	F	U
Hydrocyanic Acid	E	E	E	U
Hydrofluoric Acid (4%)	E	E	E	G
Hydrofluoric Acid (48%)	E	E	E	U
Hydrogen Peroxide (3%)	E	E	E	E
Hydrogen Peroxide (100%)	G	G	G	E
Hydrogen Sulfide (Dry)	E	E	E	E
Hydrogen Sulfide (Wet)	E	E	E	E
Iodine (in alcohol)	G	G	G	E
Isobutyl Alcohol	E	E	E	—
Isopropyl Acetate	E	G	E	U
Isopropyl Benzene	F	G	F	U
Kerosene	U	U	U	U
Lactic Acid (20%)	E	F	E	E
Linseed Oil	E	G	E	E
Machine Oil	E	F	E	E
Magnesium Chloride	E	E	E	E
Magnesium Hydroxide	E	E	E	U
Methoxyethyl Oleate	E	E	E	U
Methanol	E	E	E	U
Methyl Ethyl Ketone	G	U	E	U
Methylene Chloride	U	U	U	U
Metrizamide	E	E	E	E
Mineral Oil	E	E	E	E
Nickel Chloride	E	E	E	E
Nickel Salts	E	E	E	E
Nickel Sulfate	E	E	E	E
Nitric Acid (1%)	E	G	E	E
Nitric Acid (50%)	E	F	E	F
Nitric Acid (conc.)	F	U	F	U
Nitrobenzene	U	F	U	U
n-Octane	E	E	E	F
Oils (petroleum)	U	U	E	F
Oils (other)	E	U	E	E
Oxalic Acid	E	E	E	U
Perchloric Acid (70%)	F	F	F	U
Perchloroethylene	U	U	U	U
Phenol (5%)	E	U	E	U
Phenol (50%)	F	U	U	U
Phosphoric Acid (10%)	E	E	E	E
Phosphoric Acid (85%)	E	E	E	E
Phosphorous Trichloride	E	E	E	U
Physiological fluids (media milk serum urine etc.)	E	E	E	E
Picric Acid	E	G	E	—
Potassium Acetate	E	E	E	F
Potassium Bromide	E	E	E	E
Potassium Carbonate	E	E	E	E
Potassium Chlorate	E	E	E	E
Potassium Chloride	E	E	E	E
Potassium Hydroxide (5%)	E	E	E	U
Potassium Hydroxide (45%)	U	E	E	U
Potassium Permanganate	E	E	E	E
Potassium Sulfate	E	E	E	E
2-Propanol	E	E	E	U
Propylene Glycol	E	E	E	F
Propylene Oxide	E	E	E	F
Rubidium Bromide/Chloride	E	E	E	E
Shellac	G	E	G	E
Silver Nitrate	E	E	E	E
Sodium Bicarbonate	E	E	E	E
Sodium Bisulfate	E	E	E	E
Sodium Bisulfite	E	E	E	E
Sodium Borate	E	E	E	E
Sodium Bromide	E	E	E	E
Sodium Carbonate	E	E	E	E
Sodium Chlorate	E	G	E	G
Sodium Chloride	E	E	E	E
Sodium Cyanide	E	E	E	—
Sodium Dodecyl Sulfate	E	E	E	E
Sodium Hydroxide (1%)	E	G	E	U
Sodium Hydroxide (10%)	G	G	G	U
Sodium Hydroxide (conc.)	F	G	F	U
Sodium Hypochlorite	E	E	E	E
Sodium Iodine	E	E	E	E
Sodium Nitrate (10%)	E	E	E	F
Sodium Silicate	E	E	E	E
Sodium Sulfate	E	E	E	E
Sodium Sulfide	E	E	E	U
Sodium Sulfite	E	E	E	—
Sucrose	E	E	E	E
Sucrose (alkaline)	E	E	E	U
Sulfuric Acid (10%)	E	E	E	E
Sulfuric Acid (50%)	E	E	E	U
Sulfuric Acid (98%)	F	G	F	U
Sulfur Salts	F	G	F	F
Tannic Acid	E	G	E	—
Tartaric Acid	E	E	E	E
Tetrahydrofuran	U	U	U	U
Toluene	G	G	G	U
Trichloroacetic Acid	E	G	E	F
Trichloroethylene	U	U	U	U
Triton X-100	E	E	E	E
Turpentine	F	U	F	U
Urea	E	E	E	E
Xylene	U	U	U	U
Zephiran Chloride (1%)	E	E	E	E
Zinc Chloride	E	E	E	E
Zinc Sulfate	E	E	E	E

PP — Polypropylene
PE — Polyethylene
PA — Polyallomer
PC — Polycarbonate

RATINGS

U — Unsatisfactory
F — Fair (Test before using)
— Not tested
G — Good
E — Excellent

NOTE:
The above table is based on analytical reports, and to the best of our knowledge is accurate, however, no guarantee is expressed or implied. If at all possible, we strongly recommend testing the material under actual conditions of use.

IEC Rotor Part No.	Radius cm(Max)	rpm (Max)
966	24.5	5200
981	24.5	4200*
949	25.7	3100
977	20.7	5500*
227	22.9	3200
850	17.8	6300
811	16.7	6900
276	23.5	3500
259	24.1	3600
253	27.5	4500
269	27.3	5500
822	15.6	6900
825	18.6	6900
823	18.6	6900
826	13.3	4300
831	20.1	6900
832	19.8	5500
838	23.6	6300
845	18.1	6900
219	19.3	5000#
287	24.0	5000
950	25.7	3100#
972	24.5	4600#
866	15.2	6900

* Structural limit of rotor.

Estimated maximum rotor speed.

Note. All other speeds are the guaranteed minimum speeds in the PR7000M.

Table 3-6 Maximum Rotor Radius

	PLASTICS										METALS					OTHER				
STERILIZATION METHODS	PA	PC	PE	PP	PU	NL	DN	CN	NN	PS	TI	SS	AL	MB	MG	RR	BN	VN	PT	PF
MECHANICAL:																				
Autoclaving*	S	M	U	S	M	S	S	S	S	U	S	S	S	S	S	S	S	S	M	S
Ethylene Oxide Gas	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	U	U	S	S
Dry Heat 160°C 2 Hr	U	U	U	U	U	U	U	U	U	U	S	S	U	S	S	U	U	M	U	U
CHEMICAL:																				
Ethanol	S	S	S	S	U	S	S	S	S	M	S	M	S	S	S	S	S	S	S	S
40% Formalin	S	S	S	S	S	S	S	S	S	U	S	M	S	S	S	S	S	S	S	S
Methanol	S	U	S	S	M	S	S	S	S	M	S	M	S	S	S	S	S	S	S	S
2-Propanol	S	U	S	S	M	S	S	S	S	S	S	U	U	U	U	S	S	S	S	S
5% Sodium Hypochlorite**	M	S	U	U	S	S	U	U	S	S	S	S	S	S	S	M	M	S	M	S
3% Hydrogen Peroxide	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S	M	S
100% Hydrogen Peroxide	S	S	S	S	S	S	S	S	U	S	S	M	S	S	S	U	U	M	U	U
5% Phenol Solution	S	M	M	S	M	M	M	M	M	U	M	M	M	M	M	U	U	S	U	S

* Autoclaving
121° C - 20 MIN @
2 ATM (15 PSIG)

** Household Bleach

S = SATISFACTORY
M = MARGINAL
U = UNSATISFACTORY

PA - POLYALLOMER
PC - POLYCARBONATE
PE - POLYETHYLENE
PP - POLYPROPYLENE
PU - POLYURETHANE
NL - MODIFIED PHENYLENE OXIDE (NORYL)
DN - ACETAL HOMOPOLYMER (DELRIN)
CN - ACETAL COPOLYMER (CELCON)
NN - NYLON
PS - POLYSTYRENE

TI - TITANIUM
SS - STAINLESS STEEL
AL - ALUMINUM
MB - MANGANESE BRONZE
MG - MAGNESIUM
RR - RUBBER
BN - BUNA-N
VN - VITON
PT - PAINTED SURFACES
PF - PHENOLIC FIBER

WARNING

This chart is for material compatibility only and does not guarantee sterilization.
Also, the chemical compatibility in this chart is for decontamination only. When centrifuging these chemicals use the CHEMICAL RESISTANCE CHART.

Table 3-7 Compatible Decontamination Processes

3.5 Care and Cleaning of IEC Rotors and Structural Accessories

WARNING

If the instrument or any part has been exposed to, or used to process, dangerous pathogenic, or radioactive material, it must be decontaminated.

Centrifuge rotors and accessories that are contaminated with both biohazardous and radioactive material must *first* be sterilized.

Use standard laboratory procedures to decontaminate the instrument or part that may have accumulated blood, or, any other chemical deposits.

Refer to NIH publications Biohazards Safety Guide, Laboratory Safety Monograph, and Radiation Safety Guide.

Most IEC rotors and accessories may be sterilized by using the standard, Ethylene oxide (EtO) lab procedure or, autoclaved for sterilization as follows:

1. Autoclave the rotors and accessories before cleaning.

WARNING

Polycarbonate accessories will be seriously degraded with repeated autoclaving.

2. Loosen, or remove all caps before autoclaving to prevent tube collapse.

3. Autoclave rotors and accessories at 121°C (250°F) @15 psig for 20 minutes.

Check with manufacturers of non-IEC parts for specific sterilizing instructions.

In order to prevent deterioration and subsequent replacement of parts, the following procedures should be completed:

3.5.1 Corrosion

An important precaution to be taken by the user of a centrifuge is to prevent the corrosion of rotors and structural accessories. These parts are manufactured by IEC and are properly finished and checked by quality control facilities before they leave the factory. Consideration has been exercised to provide the maximum resistance to corrosion. However, it is essential for proper operation and safety that the operator continue a high standard of preventative maintenance to maintain maximum resistance to corrosion. If corrosion is allowed to continue small cavitities may result.

3.5.2 Inspection

The rotor and the adapters should be periodically examined for deterioration. Particular attention should be given to the rotor. If these conditions are discovered, discontinue the use of the part immediately and consult IEC.

3.5.3 Prevention

The hazard of deterioration can be reduced by conscientious user technique. If material is spilled into the part, the part should be washed out with a mild, liquid detergent solution (do not use dishwasher detergent) and the cavities scrubbed with a stiff test-tube brush having end bristles and a non-metallic tip. The part should then be rinsed in warm water and finally, in distilled water. When caustic materials are run, this procedure should be carried out immediately upon termination of the run.

3.5.4 Drying

After the part has been thoroughly cleansed it is important to dry it properly, preferably by wiping it with a clean, absorbent towel. A drying oven may be used, but the temperature should not exceed 80°C.

Rotors should be stored open to the atmosphere with cavities down.

Parts should be stored on a soft surface to prevent damage to finished surfaces.

After the proper cleaning and drying procedures have been followed, store the part clean and dry at room temperature.

Parts should not be stored wrapped in a plastic bag.

3.5.5 Corrosion Removal

If surface corrosion occurs, it is of the utmost importance to remove it immediately. The following procedure is recommended:

1. The part should be soaked to remove deposits from the metal surface. Use a mild, liquid detergent solution. ***Do not*** use dishwater detergents which contain strong alkalies.

2. Scrub the part thoroughly with a stiff test-tube brush having end bristles and a non- metallic tip.

3. Allow the part to soak again in clear warm water for a minimum of one hour.

4. Rinse the part thoroughly in warm water first, then rinse it again in distilled water.

5. Dry the part thoroughly with a clean, absorbent cloth.

6. If corrosion is deep and cannot be removed with a tube brush, the item is unsafe. **Discard the item** order a replacement from your authorized dealer.

3.6 Cleaning the Centrifuge

The centrifuge should be maintained in a clean condition to insure satisfactory operation and to increase service life.

The following procedure is recommended:

1. Unlatch and open the cover of the centrifuge. Remove the rotor.

2. ALWAYS UNPLUG THE POWER CORD FOR SAFETY BEFORE CLEANING.

3. Check the chamber for spillage or broken glass. Remove glass with a vacuum cleaner if possible

Gray dust may be the result of finely-ground glass. This must be removed to avoid sample contamination, and to prevent abrasion of the inside surfaces and cushions.

4. Remove liquids, and clean the chamber with a damp sponge.

Clean the inside of the chamber and then the outside of the cabinet, using a moist (not wet) sponge, with warm water and a mild liquid detergent, or, use a bathroom spray cleaner. Repeat using clear, warm water. Do not use dishwater detergents.

5. Observe the following precautions at ***all*** times:

(a) ***Never*** use an abrasive cleanser or steel wool pads. Remove stubborn stains with a plastic scrub pad.

(b) ***Never*** pour water into the chamber.

(c) ***Never*** use strong oxidants, aromatic solvents, esters, ketones, or chlorinated solvents when cleaning the centrifuge cover.

WARNING

When the cleanup involves hazardous, contaminated, or radioactive material, wear rubber gloves and take any other precautions appropriate to the hazards involved. Contact laboratory safety personnel for detailed information.

6. Dry the chamber thoroughly.

7. Wipe the outside of the centrifuge clean and remove any water that may have been spilled on the floor.

3.7 IEC Rotor Derating Factors vs. Specific Gravity of Rotor Contents

Refer to Table 3-4.

3.8 Cover Safety Latch Interlock Bypass

This centrifuge protects the user by locking the cover closed during the run.
This safety feature may be bypassed for removing a sample in case of a power failure.

WARNING

IF, AT THE TIME OF A POWER FAILURE THE ROTOR IS STILL SPINNING *WAIT* AT LEAST TWENTY MINUTES *BEFORE* ATTEMPTING TO OPEN THE COVER TO GUARANTEE THAT THE ROTOR IS STOPPED.

THE MACHINE POWER CORD MUST BE UNPLUGGED. DO NOT BYPASS THE COVER SAFETY INTERLOCK AS A ROUTINE OPERATION BECAUSE OF DANGER TO THE USER.

NOTE

The centrifuge has been designed to protect the user by preventing the opening of its chamber cover during operation. However, in an emergency, or during installation and for servicing purposes, it is possible to bypass this safety, cover latch interlock.

2. Remove the white plug button from the front, top-right corner of the cabinet. Insert a rigid, 1/8th-inch shaft-diameter tool, such as a screwdriver, approximately 3/4-inch straight into the access hole. The cover interlock will release and the cover will open.

3. Remove the tool and replace the plug button.

WARNING

The above procedure should *never* be performed when the rotor is still turning as opening the cover then will expose rotating parts. *Never* attempt to both override the interlock and to operate the centrifuge.

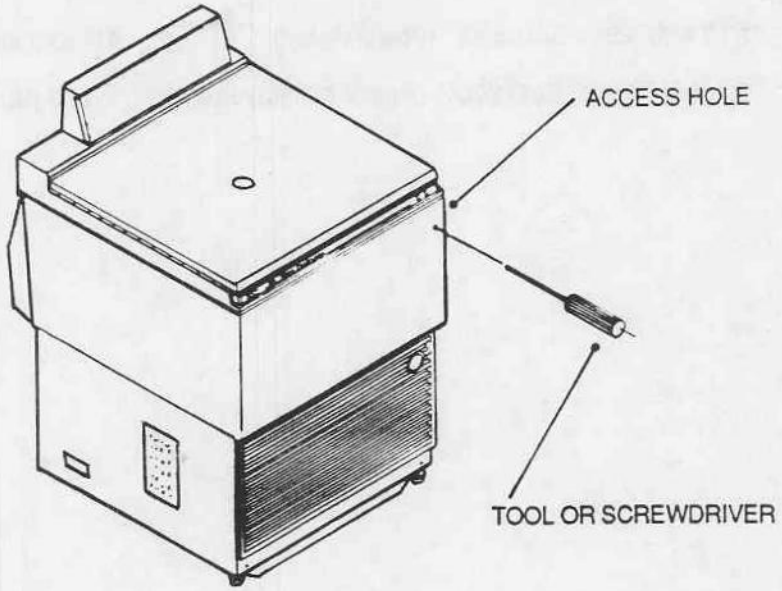


Figure 3-3 Cover Safety Latch Interlock Bypass

3.9 Fuse Replacement

The centrifuge does not have a main power circuit fuse instead it has a combination **Power** switch and circuit breaker **CB1.** Refer to Figure 3-1.

CB1 is used to control power to, as well as provide main electrical power circuit overload protection for, the entire centrifuge.

If an electrical circuit overload occurs within the centrifuge the switch will automatically open thereby shutting the power off.

If the overload condition is momentary, setting this switch off and on again will re-energize the centrifuge. If the overload is continuous the switch will not stay in the **ON/1** position.

In addition to **CB1** there are five fuses located on PC boards at the inside-rear of the cabinet. They are shown in Figure 4-3.

3.10 Spare Parts

The following parts are recommended as spare parts.

Item	Description	Part No.	Quantity
1.	Brush assembly	41775	One set
2.	Brush assembly cap	45476	Two
3.	20 Amp. SLO BLO, 250V fuse (power elect. panel)	65003 (Littelfuse 326020)	One
4.	3 AMP Fast-acting 250V metric (5x20mm) fuse (Power Supply)	65199 (Littelfuse 235003)	One
5.	1/10 AMP 250V 3AG fuse (Power Board)	41333 (Littelfuse 312.001)	One
6.	6-1/4 AMP SLO BLO 250V (Power & Relay Boards)	47869 (Bussman MDA 6-1/4)	Two

SECTION FOUR

SERVICE

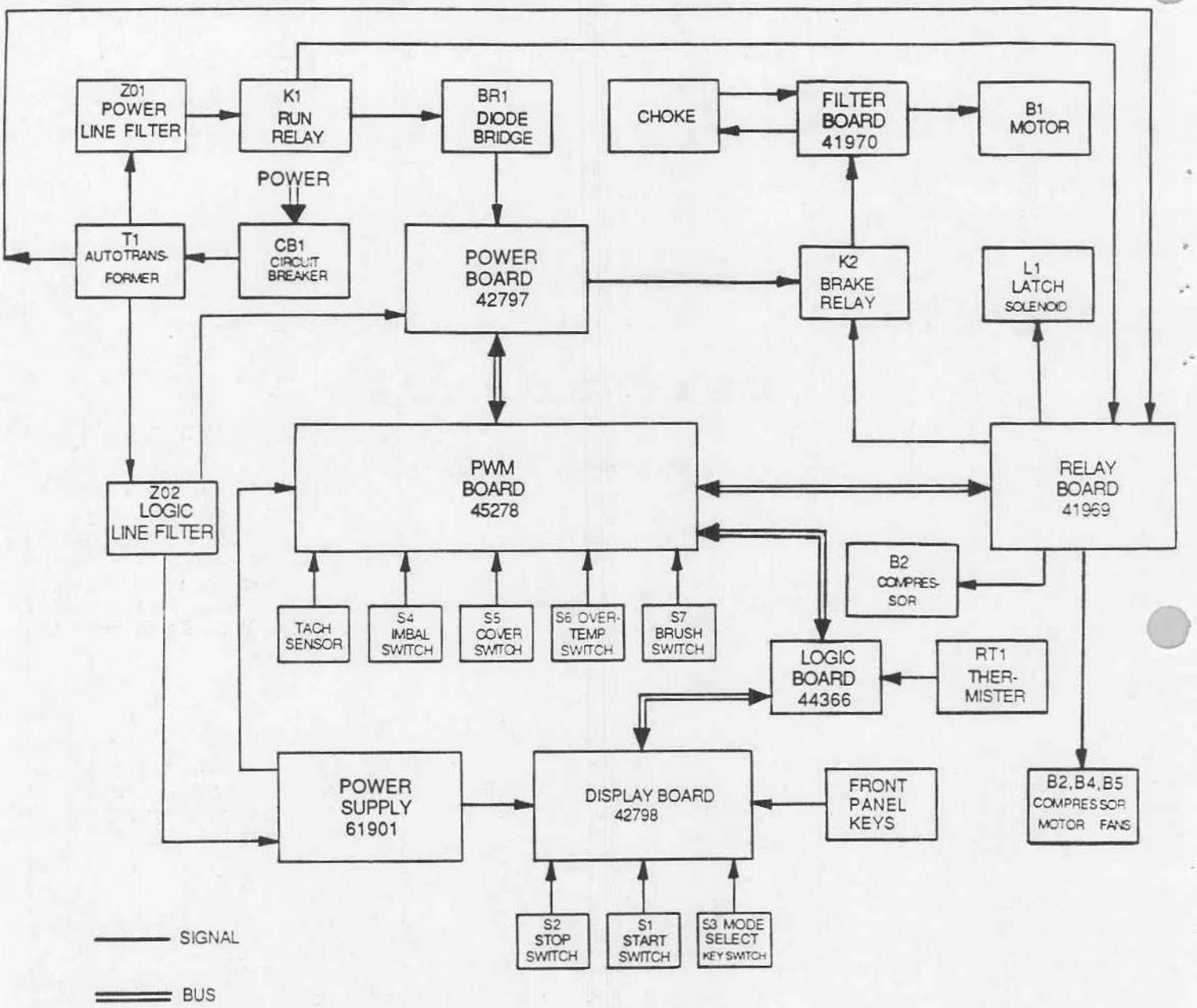


Figure 4-1 System Block Diagram

4.0 Service

4.1 General

This section contains instructions for servicing the centrifuge and is intended primarily for a service person or a maintenance technician. It contains operating theory, a trouble shooting chart, a system schematic and a system wiring diagram, and assembly drawings.

4.2 Operating Theory

Figure 4-1 is a Block Diagram of the entire centrifuge system. Refer also to the system schematic and the system wiring diagram.

4.2.1 Power Circuit

Input power to the centrifuge is supplied through a line cord equipped with a standard three-prong, twist-lock 30-ampere grounding plug. The main power switch is also a 30-ampere circuit breaker **CB1**. The main power is passed on to an autotransformer which is used to correct for different input line voltages. Refer to Section 2, paragraph 2.4.1, for the correct transformer configuration. At this point the main power separates into power to the drive motor and power to the rest of the centrifuge. The autotransformer is used to correct the voltage to either the motor drive, or, the refrigeration compressor but not to both.

4.2.2 Motor Drive Operating Description

The operation of the motor is governed by the Power Board (42797) which provides the variable voltage to the motor; and the Pulse Width Modulation (PWM) Board (45278) which controls the operation of the Power Board. The Power Board provides variable voltage to the motor by means of pulse-width-modulation control which is generated on the PWM Board. The PWM board receives tachometer feedback from a Hall effect sensor and adjusts the Power Board output voltage to maintain the desired speed of rotation of the centrifuge motor **B1.** The PWM board receives speed set commands from the Logic Board (44366) through a serial link. An inductor **L2** is connected in series with the motor to smooth the motor current. A Filter Board (41970) is connected across the motor power to reduce PWM and commutation noise from the motor.

Speed calibration is not required.

Braking is achieved by shorting the motor armature through relay **K2** and applying a low-voltage low-current drive to the motor field from the power board. The low-voltage field excitation is under PWM control to provide for variable braking levels. The braking level commands are transmitted from the logic board to the PWM board via the serial link. There are nine braking levels and a coast position. The desired braking position is selected by the user by the settings of the **Brake** switch located on the front panel. The **O** setting is coast, or no braking; the **1** setting is minimum braking; and the **9** setting is maximum braking. Refer to Figure 3-1A

4.2.3 Cover Latch Circuit

The cover can only be opened by pressing the **Stop/Open** switch **S2** when the centrifuge rotor is at zero speed (the red LED in the switch will glow). This switch is connected to the Display Board (42798). When the switch is pressed the logic board reads this switch closure from the display board and if the centrifuge rotor is at zero speed the logic board issues a command over the serial link to the PWM board to open the latch. When the PWM board receives this command from the serial link it sends a signal to the Relay Board (41969) to activate the latch solenoid **L1** and open the cover.

4.2.4 Logic Board (44366)

The Logic Board (41604) provides the overall centrifuge control. This board scans all of the front panel keys, lights all of the front panel displays, and measures the centrifuge chamber temperature. All other centrifuge control is accomplished by sending commands over the serial link to the PWM board. These commands sent over the serial link include, run/stop commands, speed and acceleration commands, refrigeration compressor on/off commands, and cover latch open commands. In addition to these the logic board receives the following centrifuge status information via the serial link, Open Cover switch **S5**, Imbalance switch **S4**, chamber Overtemperature switch **S6**, Worn Brush switch,**S7**, and present rotor speed.

4.2.5 Display Board (42798)

The Display board (42798) provides operating and monitoring information to the user in the form of digital LED displays. The smaller green displays indicate set-values for the different parameters and the larger red displays indicate the present actual values.

4.2.6 Power Supply (61901)

The dual, 5 Vdc and 12 Vdc, power supply provides low-voltage power to the logic board, the display board and PWM board. An external 3/10 ampere SLO BLO fuse F1 protects the power supply from overvoltage and short-circuit conditions.

4.2.7 Refrigeration Circuit Description

The refrigeration compressor motor **B2** and the two compressor fans **B3** and **B4** are controlled by the PWM board through the relay board. These fans are also turned on with the drive motor cooling blower **B5** when the drive motor is running.

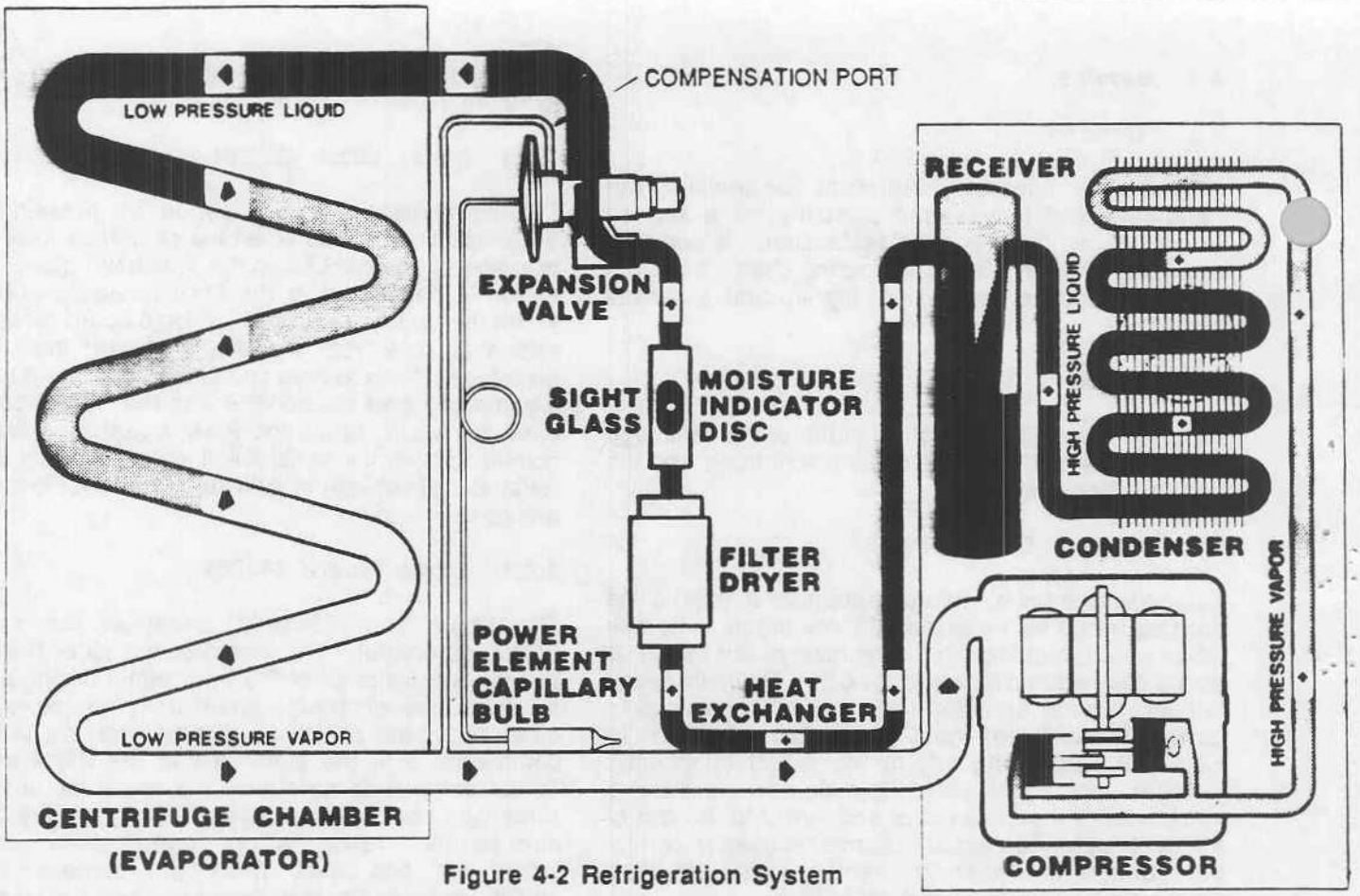


Figure 4-2 Refrigeration System

4.2.9 Refrigeration System Descripton

The refrigeration system used in this centrifuge uses a simple compression-expansion refrigeration cycle.

The system consists of a one HP motor-compressor, a condenser, fans and receiver mounted to a common base. A filter-drier, a moisture-indicator sight glass, a heat exchanger, a thermostatic expansion valve, and an evaporator, and associated plumbing complete the system. In operation, the compressor brings the refrigerant to a high pressure and temperature as a vapor, and forces this vapor through a fan-cooled condenser.The refrigerant exits from the condenser as a lower-temperature liquid, still at high pressure, and passes to the receiver for storage. From the receiver the refrigerant passes through one side of a heat exchanger, to perform four functions: (1) heat the refrigerant vapor returning to the compressor, to prevent frosting or condensation on its tubing, (2) subcool the liquid refrigerant in the liquid line to prevent formation of flash gas, (3) evaporate any refrigerant in the suction line to prevent refrigerant returning to the compressor in liquid from, and (4) improve the system efficiency.

From the heat exchanger, the refrigerant passes into a filter-drier and sight glass. The filter-drier filters out foreign matter, and removes any moisture. The sight glass provides a visual check on refrigerant quantity and moisture content. Bubbles, or foaming, indicate a shortage of refrigerant, and a green-to-yellow change in the sight-glass disc is an indication of moisture.

From the sight glass the refrigerant passes through the thermostatically-controlled expansion valve.

A capillary bulb and compensation port, at the output of the centrifuge chamber evaporator senses the temperature of the vapor leaving the evaporator, and varies the expansion valve orifice so as to keep a reasonably constant output temperature by varying the flow through the expansion valve. As the gas expands through the valve, it expands and drops in pressure, taking up the heat from its surroundings as it boils into its vapor state. This process of taking up heat during vaporization is the means of cooling the walls of the centrifuge chamber, to provide an internal temperature at any desired value within the equipment limits.

The low-pressure vapor which exits from the evaporator then flows to the compressor for repetition of the cycle.

4.3 Lubrication

Lubrication is ***not*** required for this centrifuge. The drive motor is permanently lubricated for the life of the unit. ***DO NOT*** attempt to lubricate this motor; otherwise damage may occur.

4.4 Troubleshooting

Table 4-1 provides possible remedies to problems.

WARNING

Some trouble shooting procedures require the services of qualified service personnel to be exposed to electrical shock areas where potentially-lethal voltages exist.

Unplug **the centrifuge whenever possible** ***before*** **attempting any maintenance.**

TABLE 4-1

TROUBLESHOOTING CHART

SYMPTOM	POSSIBLE CAUSE	SUGGESTED REMEDY
1. No control panel displays.	No voltage reaching machine. Low-voltage power supply fuse.	Check power outlet and power cord. Check low-voltage power supply fuse.
	Defective Power circuit breaker.	Check for 200/240 VAC across Power circuit breaker. With power cord unplugged, check continuity on both sides of circuit breaker.
	Defective low-voltage power supply.	Check 5 &12 VDC outputs of power supply.
2. No zero speed indication. (Stop/Open LED not lit).	Loose Stop/Open switch wiring.	Check Stop/Open switch wiring.
	Defective speed switch.	Replace speed switch.
	Open wiring.	Check wiring point to point.
3. Stop/Open LED is ON but cover will not open.	Stop/Open LED.	Check Stop/Open LED.
	Defective solenoid. Defective relay board.	Check solenoid continuity. Replace relay board.
	Open wiring.	Check wiring point to point.
4. No motor operation	Refer to Figure 4-2 Motor trouble-shooting flow diagram.	
5. Erratic speed.	Improper tachometer signal.	Check alignment of sensor and magnetic wheel.
	Defective motor brushes.	Replace motor brushes.
	Defective PWM board.	Replace PWM board.
	Defective Motor.	Replace motor.
6. No soft/normal accel.	Defective PWM board.	Replace PWM board.
	Defective power board.	Replace power board.
7. Electrical shock when touching case during operation.	Improper or faulty power line or power socket grounding. Internal grounding wire loose or disconnected.	Centrifuge must be properly grounded (3-wire). **DO NOT** use 2-wire adapter.
8. No braking action.	Open wiring on brake relay.	Check wiring.
	Defective brake relay.	Replace brake relay.
	Blown fuse F1 on power board.	Replace fuse F1 on power board.
	Open motor field /armature connection.	Check wiring.
	Defective power board.	Replace power board.
9. Erratic temperature reading.	Intermittant wiring.	Check wiring.
	Defective thermister RT1.	Replace if faulty.
	Defective logic board.	Replace logic board.
10. No refrigeration.	Open wiring.	Check wiring.
	Defective relay	Replace relay board.
	Defective logic board.	Replace logic board.

TABLE 4-1
TROUBLESHOOTING CHART (con't)

SYMPTOM	POSSIBLE CAUSE	SUGGESTED REMEDY
	Incorrect high/low side pressure.	Use service valves to check pressure.
	Defective compressor.	Replace compressor.
11. Chamber will not pull down to desired temperature.	Loss of refrigerant.	Find leak. Replace refrigerant.
	Guard bowl heavily frosted.	Turn off refrigeration and allow frost to melt. Place a container of hot water in the bowl or use a hot air gun to expedite defrosting.
	Compressor malfunctioning.	See 12, 13, and 14 below on compressor problems.
	Defective compressor.	Replace compressor.
	Rotor operated at higher speed than recommended.	Lower speed to maximum recommended speed.
	Condenser not getting sufficient cool air.	Clean condenser fins. Straighten any bent fins. Ensure that front louver and rear grille covers are not blocked. Check condenser fans for proper operation.
	Ambient temperature above 90° (32°C).	Correct Ambient temperature.
	Control set too high.	Lower setting to desired temperature.
	Thermistor RT1 failed(tempera- indicator will read wrong).	Replace if faulty.
12. Compressor will not start and motor does not hum.	Open wiring.	Check point to point.
	Open motor windings.	Replace compressor.
	Temperature control set above chamber temperature.	Reset control.
13. Compressor will not start, motor hums.	Low line voltage.	Check line voltage under load.
	Shorted or grounded motor windings.	Replace compressor.
	Internal damage in compressor motor.	Replace compressor.
	Starting capacitor defective.	Determine reason and replace starting capacitor.
	Starting relay defective.	Momentarily make relay contacts and see if compressor starts.
14. Compressor starts, trips overload protector.	Low line voltage.	Check line voltage under load.
	Excessively high discharge pressure.	Check that condenser is clear, and is being adequately cooled. Check for line restrictions and overcharge (may be frost on compressor or suction line).
	Inadequate compressor cooling.	Check that all vents are not obstructed.

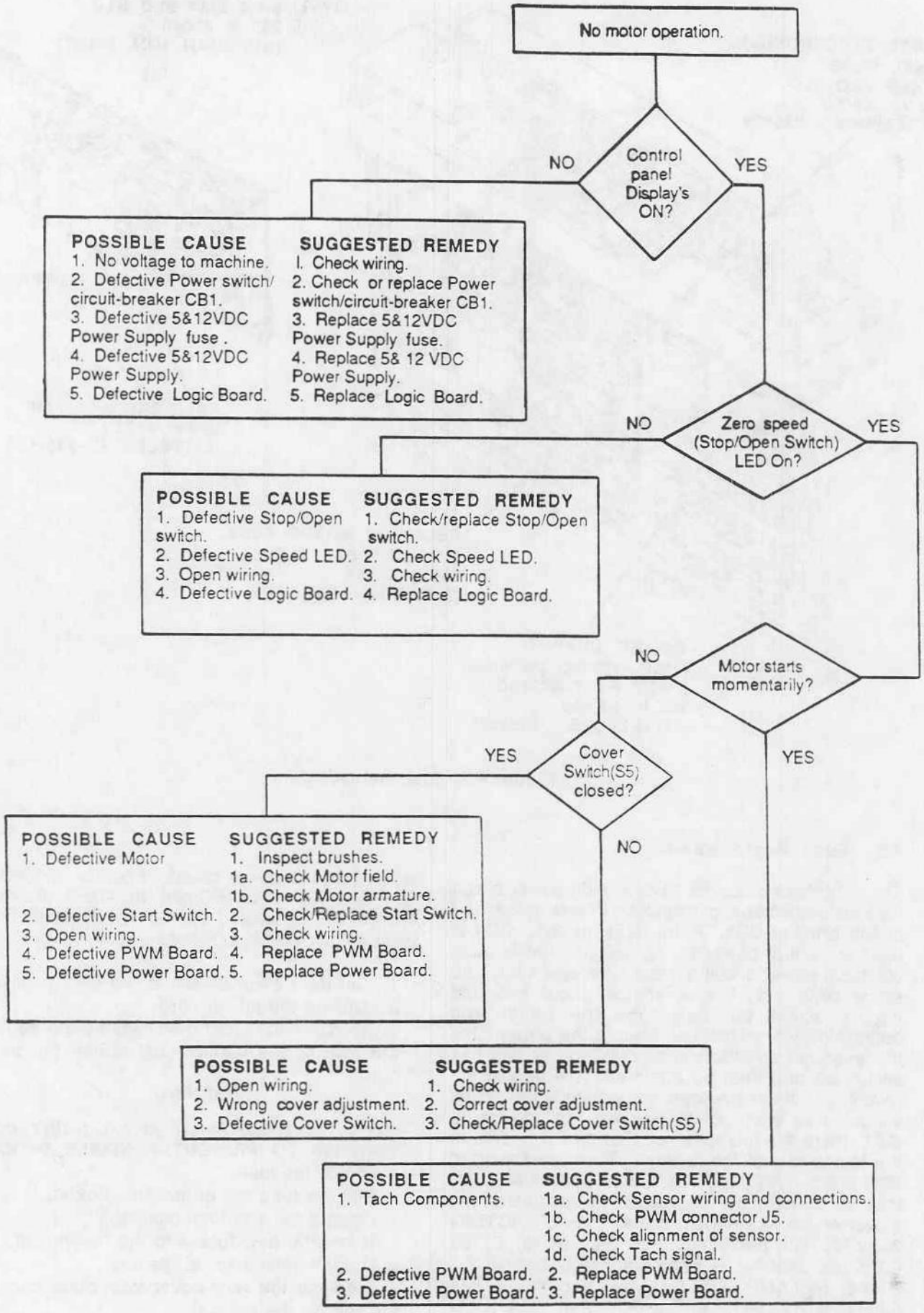


Table 4-2 Motor Trouble Shooting Flow Diagram

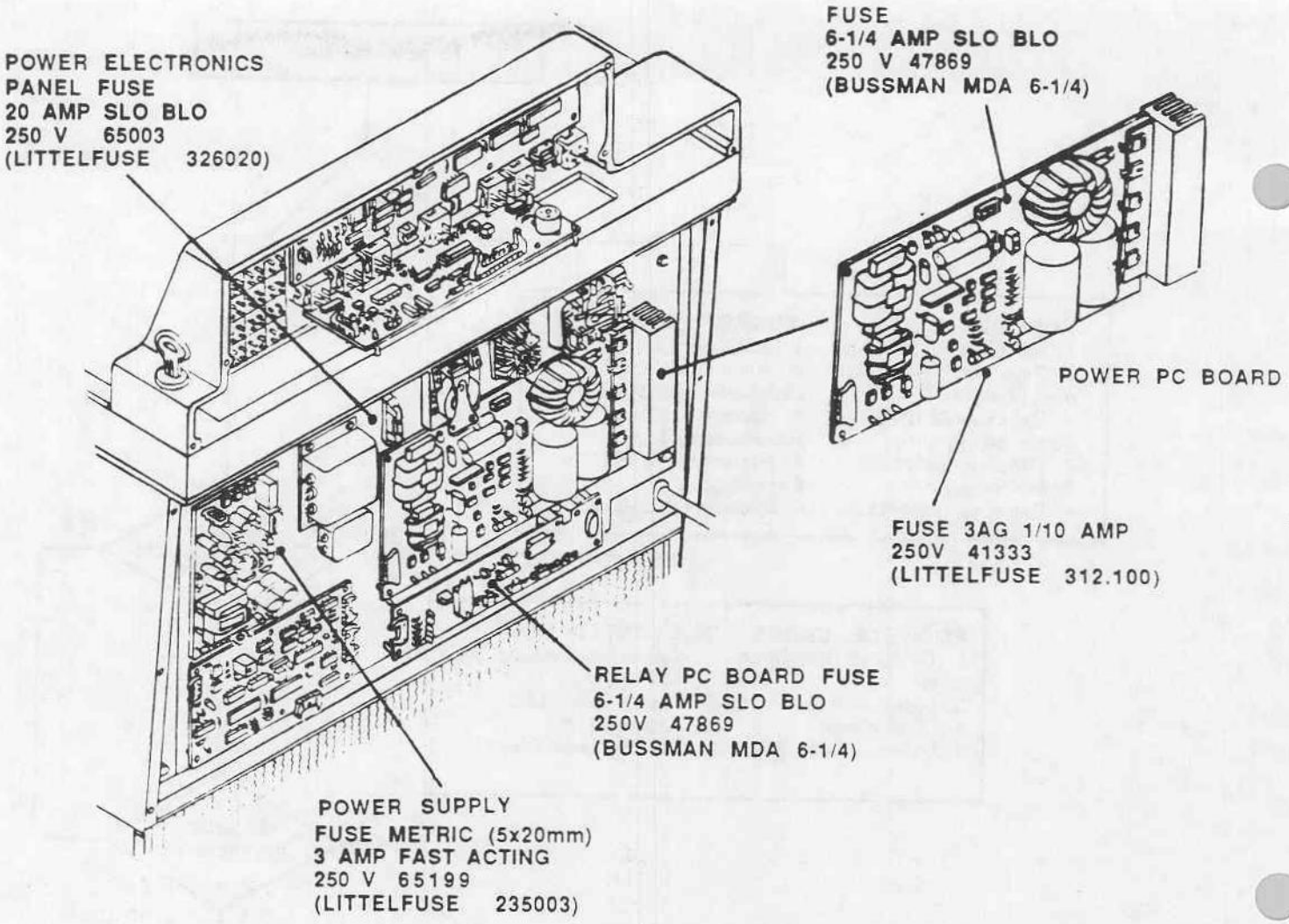


Figure 4-3 Fuse Replacement

4.5 Fuse Replacement

The centrifuge does not have a main power circuit fuse instead it has a combination **Power** switch and circuit breaker **CB1**. Refer to Figure 3-1. **CB1** is used to control power to, as well as provide main electrical power circuit overload protection for, the entire centrifuge. If an electrical circuit overload occurs within the centrifuge the switch will automatically open thereby shutting the power off. If the overload condition is momentary, setting this switch off and then on again will re-energize the centrifuge. If the overload is continuous the switch will not stay in the **ON/1** position. In addition to **CB1** there are five fuses located on PC boards at the inside-rear of the cabinet. They are shown in Figure 4-3. A 20 AMP SLO BLO 250V fuse, IEC part No. 65003 (Littelfuse 326020) is located on the power electronics panel. A 3 AMP FAST ACTING 250V METRIC (5x20mm) fuse, IEC part No. 65199 (Littelfuse 235003), is located on the power supply. A 3AG 1/10 AMP 250V fuse, IEC part No. 41333 (Littelfuse 312.001) and a 6-1/4 AMP SLO BLO 250V, IEC part No. 47869 (Bussman MDA 6-1/4) are located on the power board. Another 6-1/4 AMP SLO BLO 250V fuse, IEC part No. 47869, (Bussman MDA-6-1/4) is located on the relay board. These fuses are accessible as follows:

1. Set the **Power** switch to the OFF position.
2. Unplug the power cord.
3. Remove the rear cover vent-plate panel at the rear of the cabinet just above the power cord.

WARNING

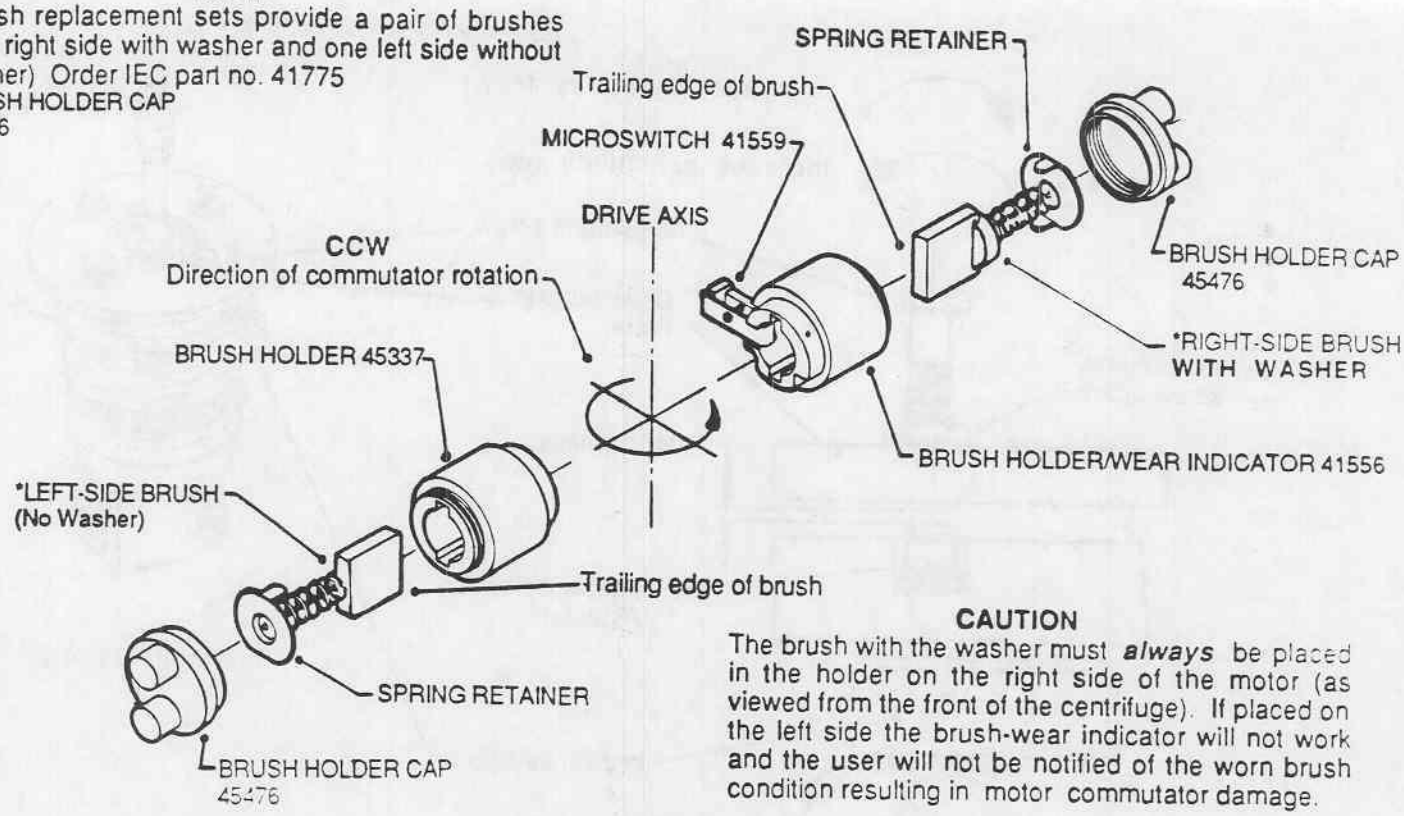
AVOID CONTACT WITH ANY CIRCUIT COMPONENTS TO PREVENT POSSIBLE SHOCK.

- Locate the fuse.
- Pull the fuse out of the fuse holder.
- Discard the bad fuse assembly.
- Insert the new fuse into the fuseholder.
- Order a new fuse at this time.

4. Replace the rear cover vent-plate panel to the rear of the cabinet.
5. Plug in the power cord.

NOTE

*Brush replacement sets provide a pair of brushes (one right side with washer and one left side without washer) Order IEC part no. 41775



CAUTION

The brush with the washer must ***always*** be placed in the holder on the right side of the motor (as viewed from the front of the centrifuge). If placed on the left side the brush-wear indicator will not work and the user will not be notified of the worn brush condition resulting in motor commutator damage.

Figure 4-4 Brush Replacement

4.6 Brush Replacement

Proper attention to the motor brushes is necessary to ensure proper operation and to extend motor life. Operation with worn brushes can lead to serious damage to the motor commutator. If the worn **brush** indicator is displayed on the control panel, ***replace both*** brushes as soon as conveniently possible and definitely ***within 20 hours*** as follows:

1. Set the **Power** switch to the OFF position.

WARNING

Unplug the power cord from the wall socket TO PREVENT POSSIBLE SHOCK.

CAUTION

There are two *different* brush assemblies in the drive motor.

The brush assembly located on the right side of the motor (as viewed from the front of the centrifuge) has an additional integral part, a washer which is used to actuate the brush-wear indicator microswitch when the brush is worn. This brush with the washer must *always* be placed in the holder on the *right side* of the motor. If placed in the left side the brush-wear indicator will not work and the user will not be notified of the worn brush resulting in motor commutator damage.

The brush assembly located on the left side of the motor (as viewed from the front of the centrifuge) does not have a washer.

2. Remove the louver at the lower-front of the centrifuge.

3. Remove the set (IEC Part No. 41775) of brushes from the plastic bag that was in the original package that also contained the manual and other instructions.

4. Locate the the brush holder cap on the left side of the motor (as viewed from the front of the centrifuge). Turn the brush holder cap counter-clockwise (CCW) to remove it. Remove the old brush from the holder. Compare it to to the new brush. If they are the same insert the new brush. Replace the brush holder cap.

5. Locate the the brush holder cap on the right side of the motor (as viewed from the front of the centrifuge). Turn the brush holder cap counter-clockwise (CCW) to remove it. Remove the old brush. Note that this brush differs from the other left side brush. It has an additional part, a washer which is used to actuate the brush indicator microswitch when the brush is worn. Compare it to to the new brush. If they are the same insert the new brush. Replace the brush cap.

6. Replace the louver and order a new set (IEC part no. 41775) of brushes at this time.

7. Plug the power cord in and check for proper operation.

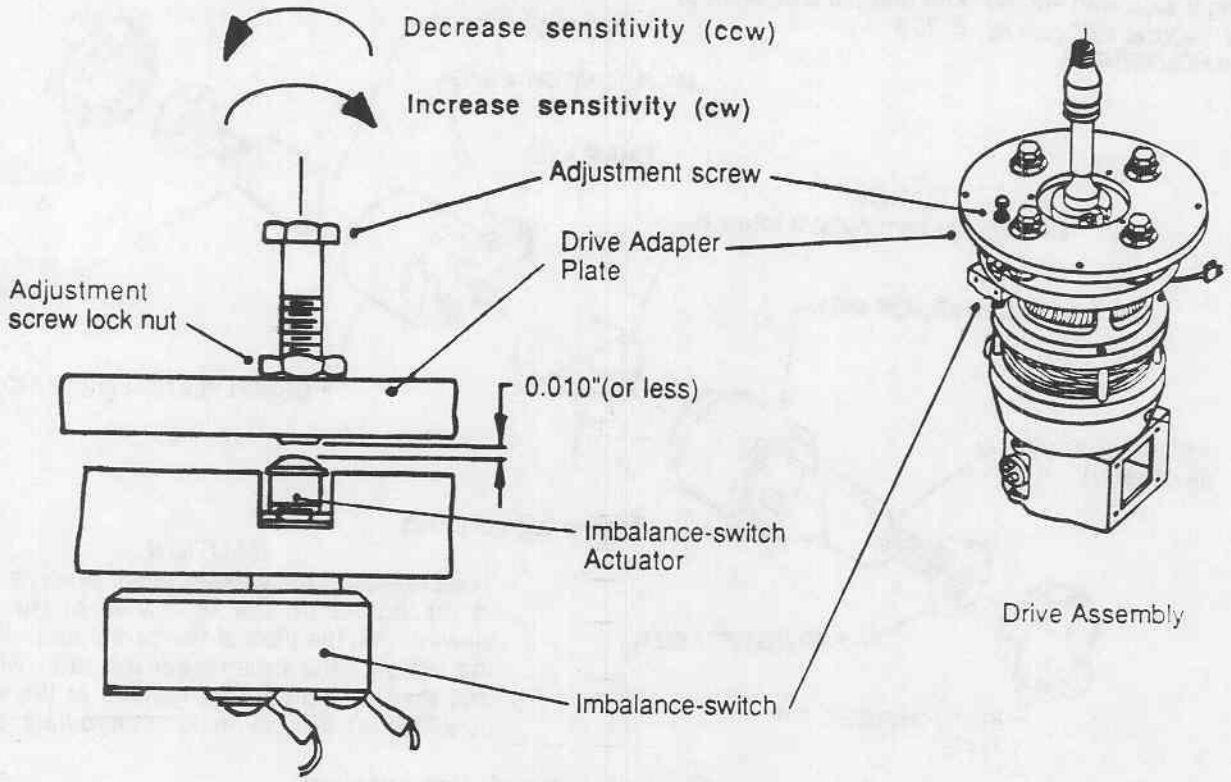


Figure 4-5 Imbalance Switch

4.7 Imbalance Switch Adjustment

Refer to Figures 4-5 and 4-10 for this procedure.

1. Set the **Power** switch to the ON position.

2. Open the chamber cover. Remove the rotor. Loosen, but do not remove, the three screws that secure the dust cap. Remove the dust cap.

3. Remove the four screws that secure the drive cover. Remove the drive cover. Remove the drive seal.

4. Locate the hex-head, 1/4-28 UNF x 1.12, imbalance-switch adjustment screw on the drive plate of the drive assembly.

5. Loosen, but do not remove, the 1/4-28 locking hex nut on the adjustment screw.

6. Turn the adjustment screw down (cw) so that it just trips the imbalance switch actuator. (The IMBALANCE diagnostic message will appear on the display. Now turn the adjustment screw up (ccw) so that it just releases the imbalance switch actuator. (The IMBALANCE diagnostic message will disappear from the display). Tighten the hex nut.

7. Replace the drive seal. Replace and secure the drive cover with the four screws.

8. Replace the dust cap. Tighten the three screws that secure the dust cap.

9. Check for proper operation.

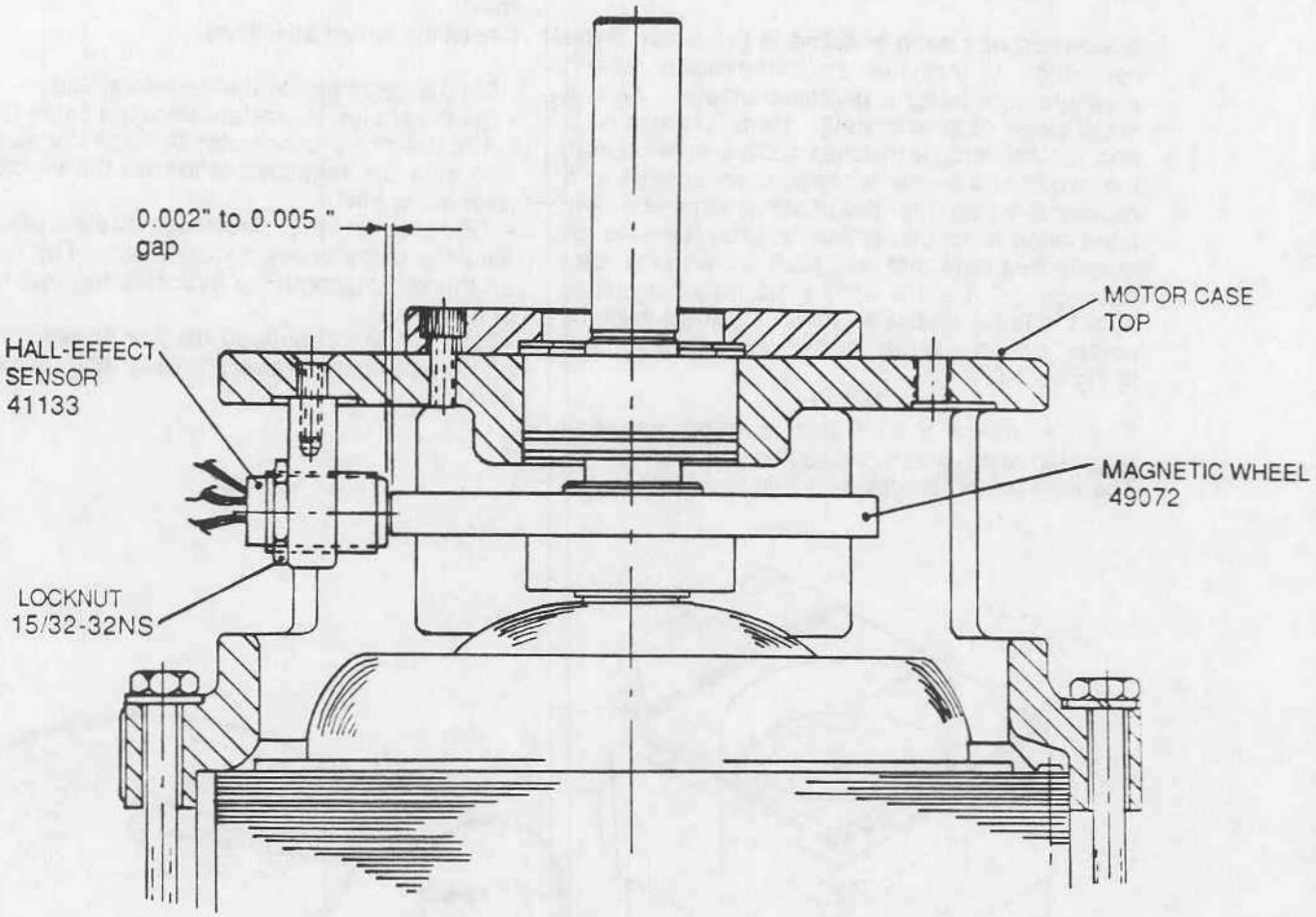


Figure 4-6 Tachometer Sensor

4.8 Tachometer Sensor Adjustment

1. Set the **Power** switch to the OFF position.
2. Unplug the power cord from the wall socket.
3. Remove the louver at the lower-front of the centrifuge.

WARNING - Avoid contact with any circuit components to prevent possible shock.

4. Locate the tachometer Hall-effect sensor at the top of the motor case.
5. Loosen but, do not remove, the locknut on the sensor mounting bracket.
6. Unscrew the sensor out a few turns in the bracket assembly. Hold a 0.002" to 0.005 "shim stock between the sensor and the magnetic wheel. Rotate the drive shaft 360° to find the minimum clearance point. Turn the sensor in until it touches the shim.
7. Remove the shim stock. Tighten the locknut.
8. Replace the louver onto the lower-front of the centrifuge.
9. Plug the power cord in and check for proper operation.

4.9 Tachometer Speed Check

A viewport has been installed in the cover of the centrifuge to provide an independent speed measurement using a phototachometer. Also, a small stripe (approximatetly 1/8 to 1/4-inch wide and 1/2-inch long) is installed radially outward from the center of the rotor windshield cover knob as a cooperative target for the phototachometer beam. If the stripe is not present on the knob, take the roll of reflective tape that was supplied with the rotor package. Cut a 1/8 wide x 1/2-inch long piece from the roll and stick it radially, outward from the center, onto the windshield-cover knob as shown in Figure 4-6A.

NOTE

The centrifuge tachometer is a 60-pole pair magnetic wheel which is detected by a Hall sensor. The time-reference device within the centrifuge is a quartz crystal, with an accuracy of a few parts per million.

Check the speed as follows:

- Set the centrifuge to the desired speed.
- Set the phototachometer dial to the same speed.
- Aim the phototachometer through the viewport and onto the reflective stripe on the windshield rotor cover knob.
- "Fine tune" the phototachometer until the spinning stripe appears motionless. The reading on the phototachometer indicates the true speed of the rotor.
-Compare the centrifuge display speed with the phototachometer speed. They should be the same.

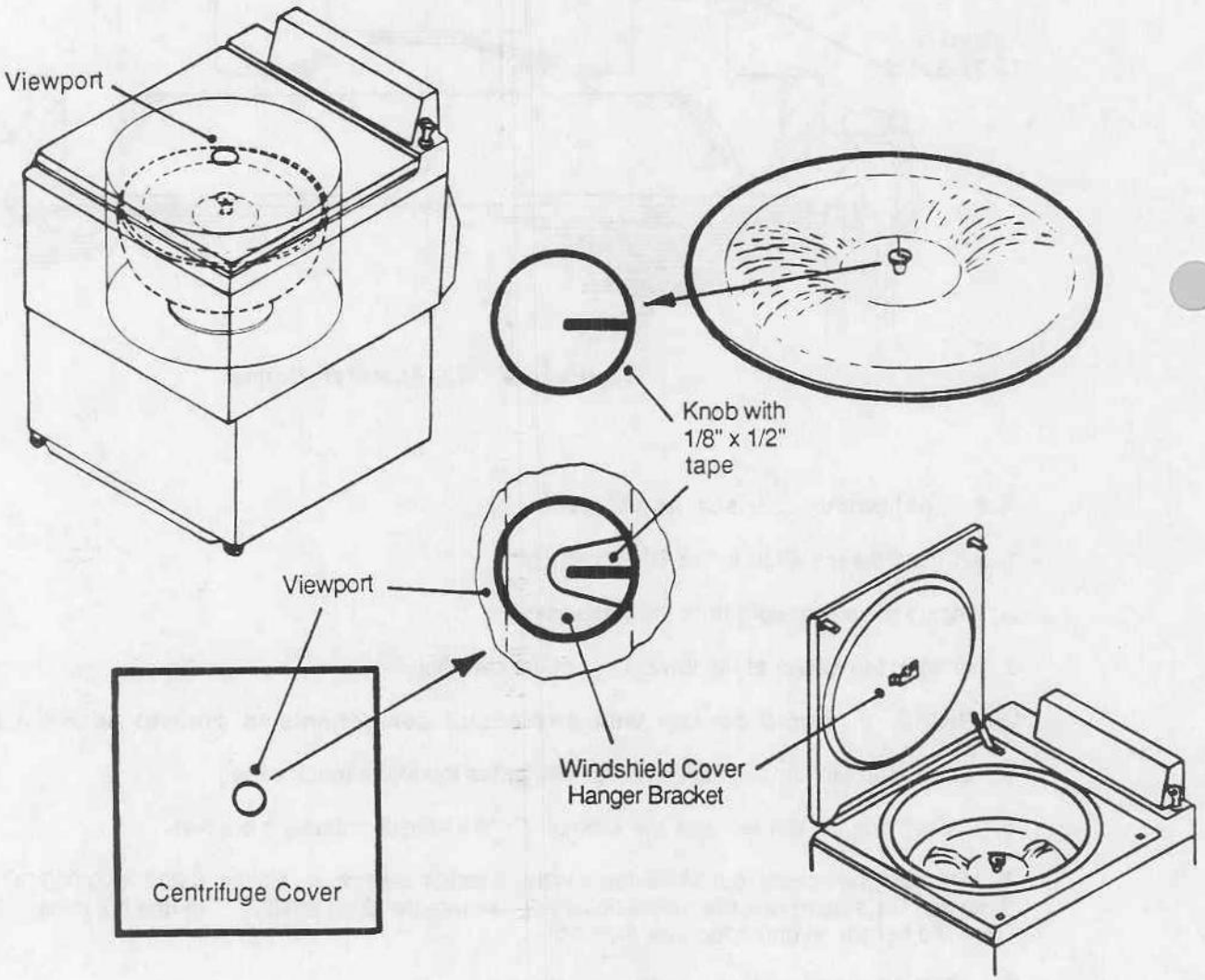


Figure 4-6A Tachometer Speed Check

4.10 Shaft Runout Check

It is extremely important that the total indicated runout (T.I.R.) of the flexible drive shaft be held to a minimum. T.I.R. is defined as the deviation from perfect concentricity of the drive shaft. The maximum allowed deviation, or T.I.R., is .003". This deviation is measured by using a dial indicator as shown in Figure 4-6B and as follows:

-Set the **Power** switch to the OFF position.

-Unplug the power cord from the wall socket.

-Remove the louver at the lower-front of the centrifuge.

WARNING

Avoid contact with any circuit components to prevent possible shock.

- Install a dial indicator set on a solid base in the centrifuge guardbowl. The guardbowl is non-magnetic therefore place a block of magnetic steel heavy enough to remain stationary, in the guardbowl as the base.

- Attach the base of a magnetic indicator set to this block in such a manner that the dial indicator may be positioned as shown.

-Turn the magnetic wheel by hand to measure the T.I.R. of the flexible shaft.The maximum allowed deviation, or T.I.R., is .003".

-Replace the louver onto the lower-front of the centrifuge.

-Plug the power cord in and check for proper operation.

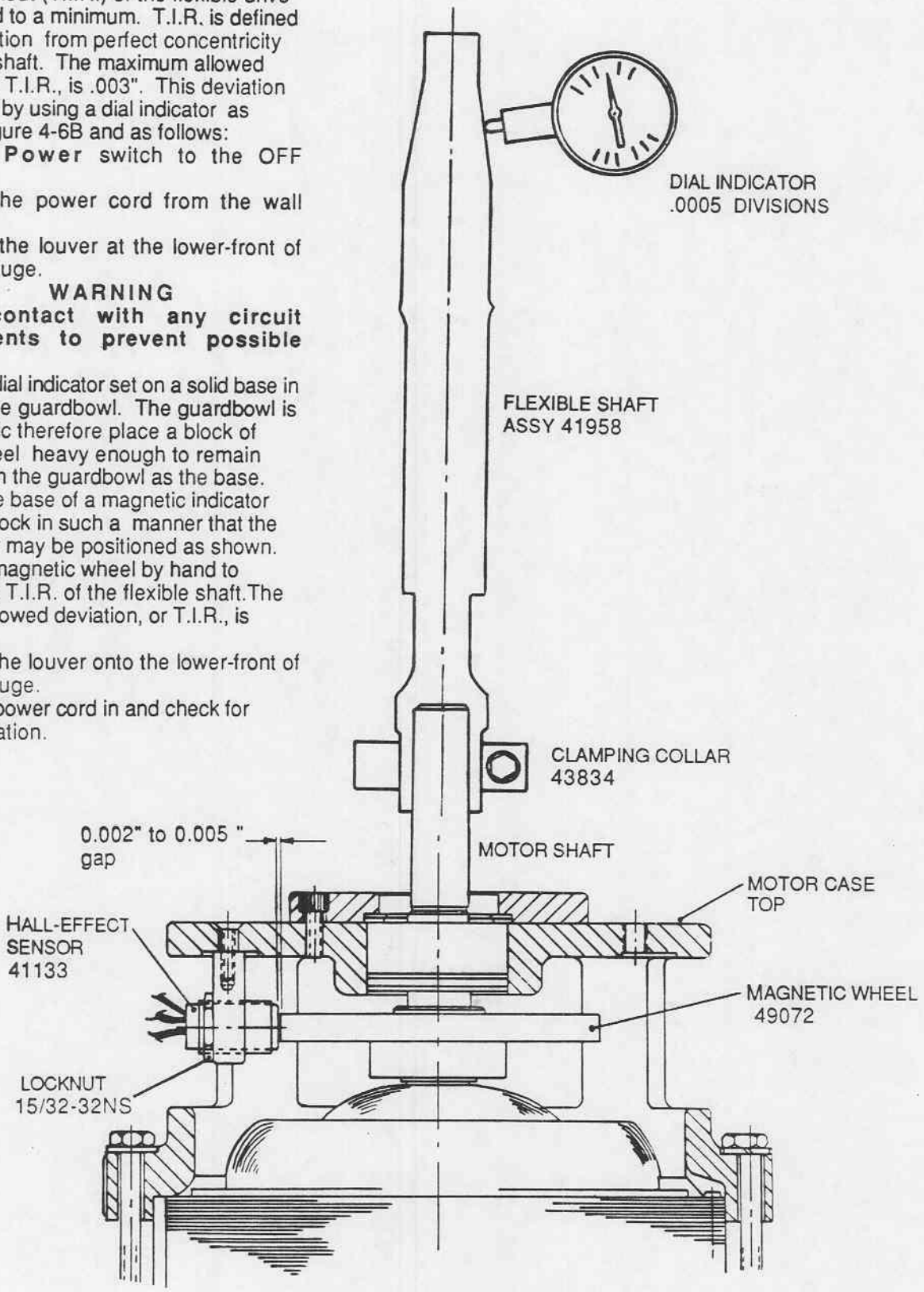
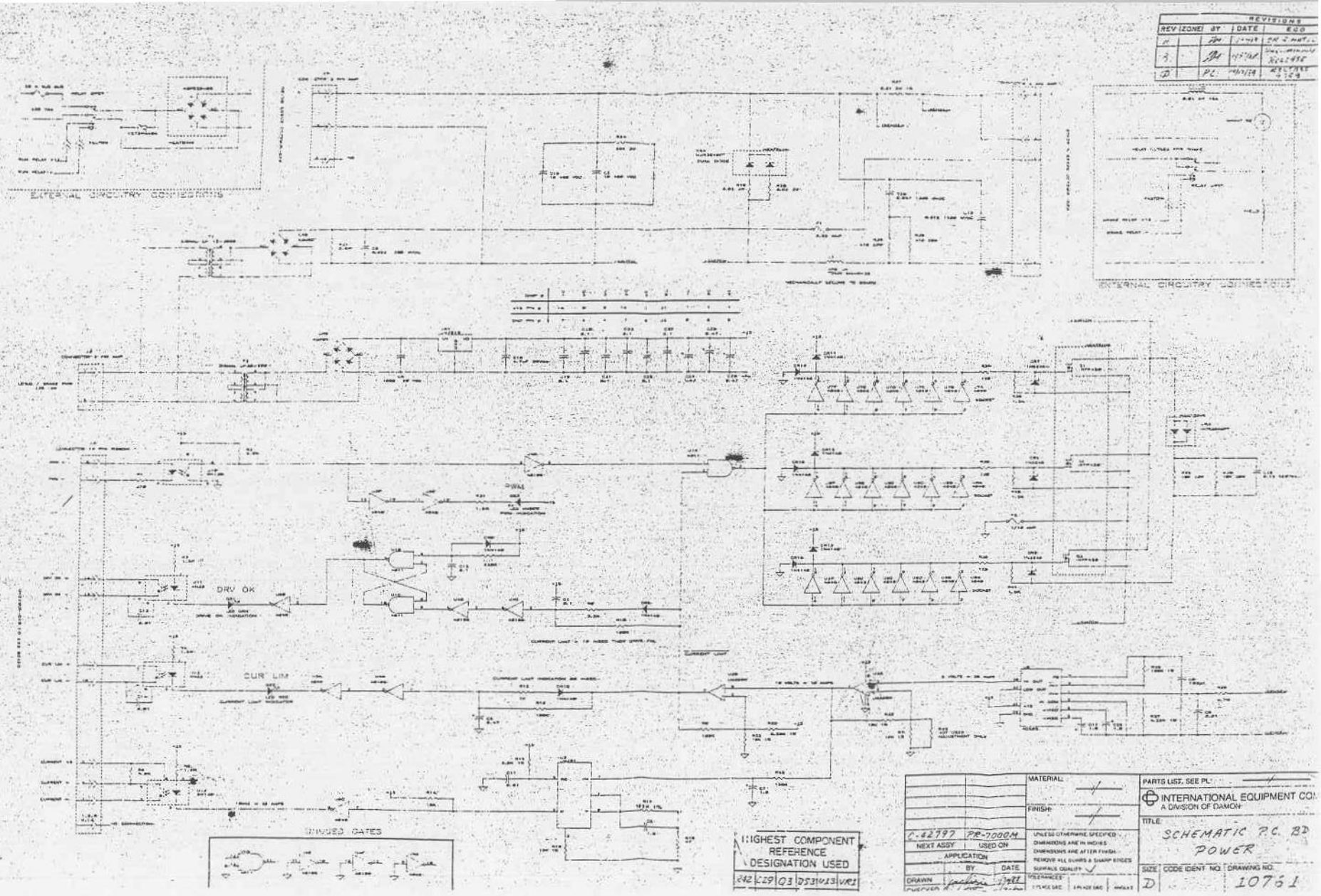


Figure 4-6B Shaft Runout Check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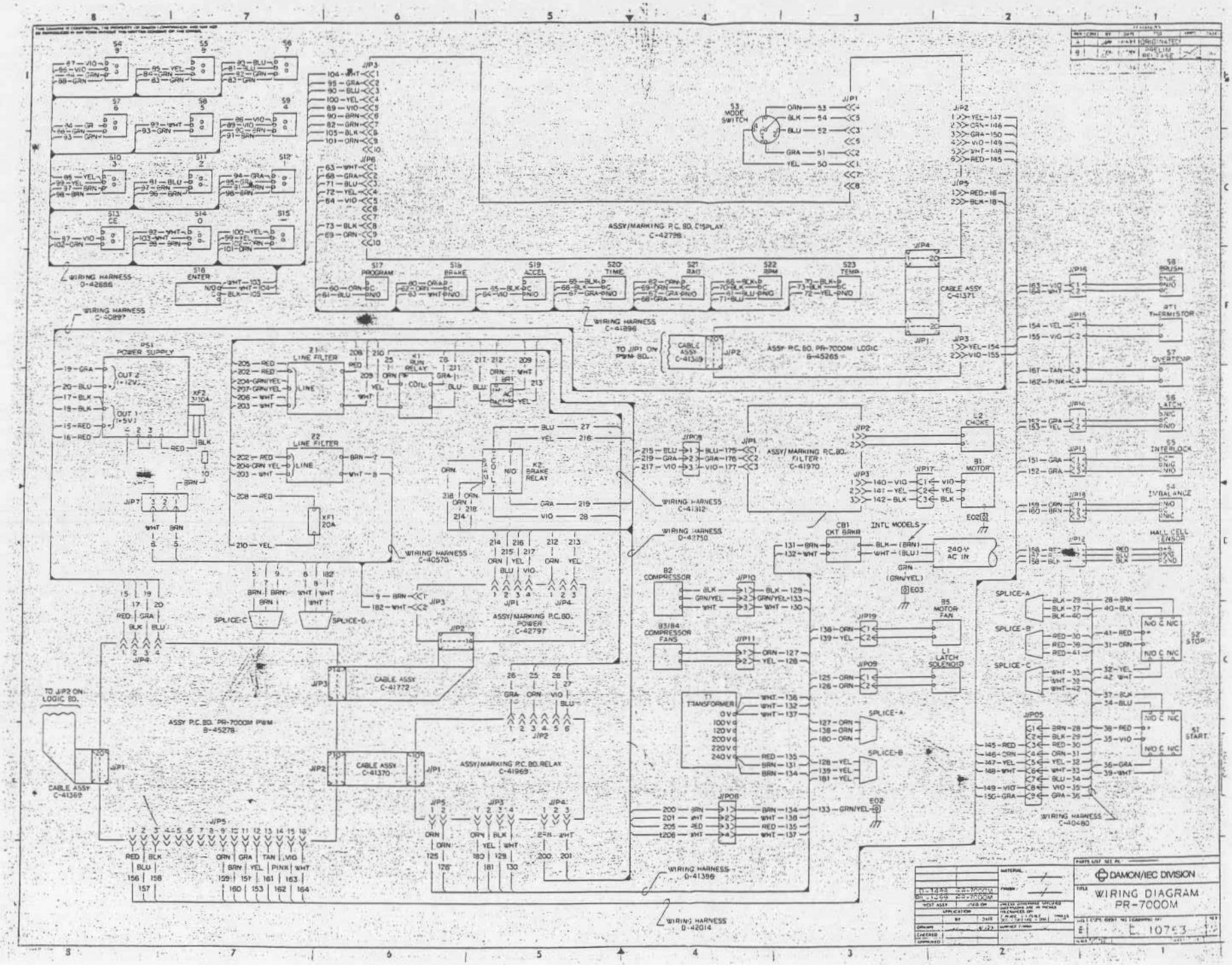
DAMON/IEC DIVISION
WIRING DIAGRAM
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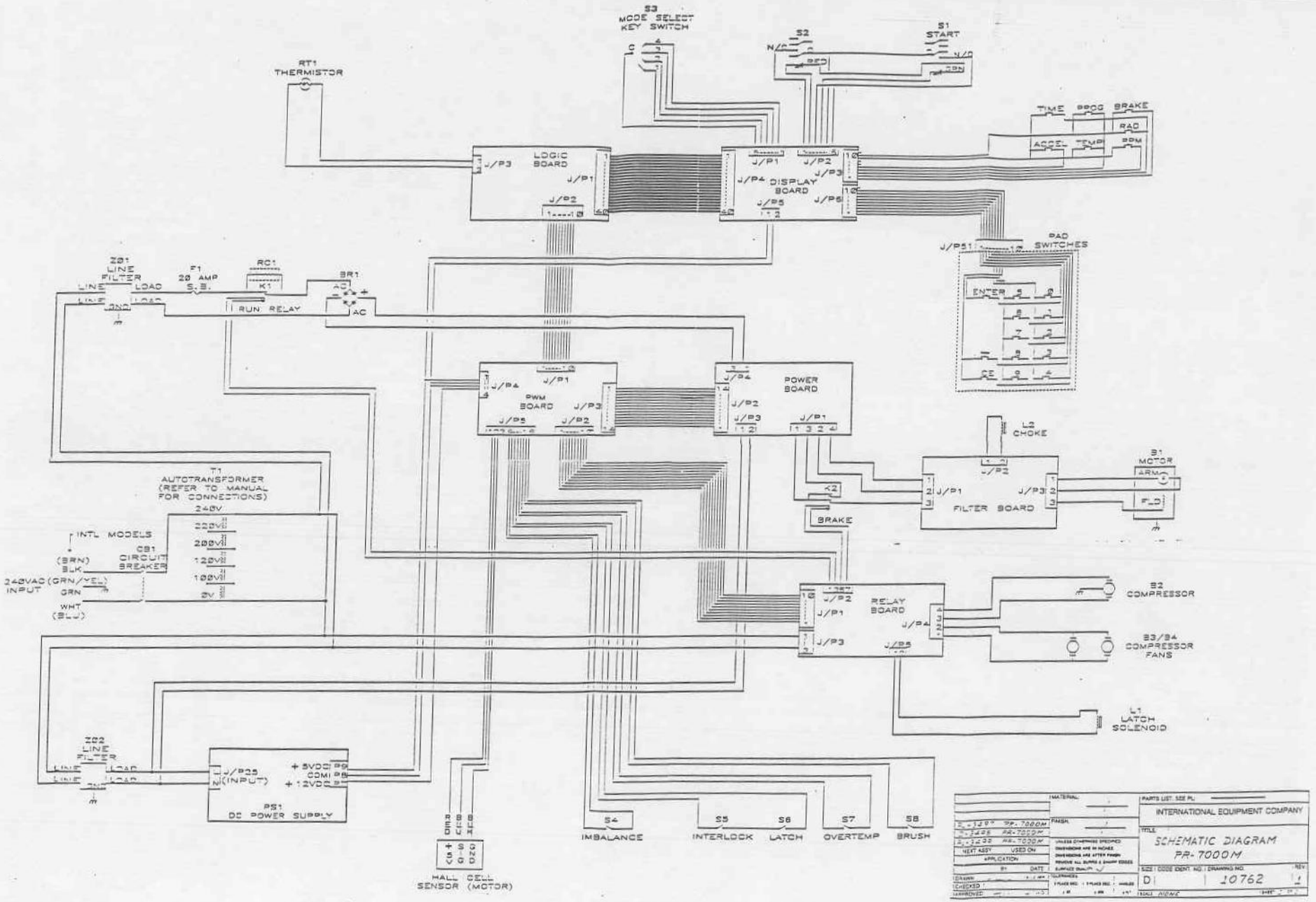
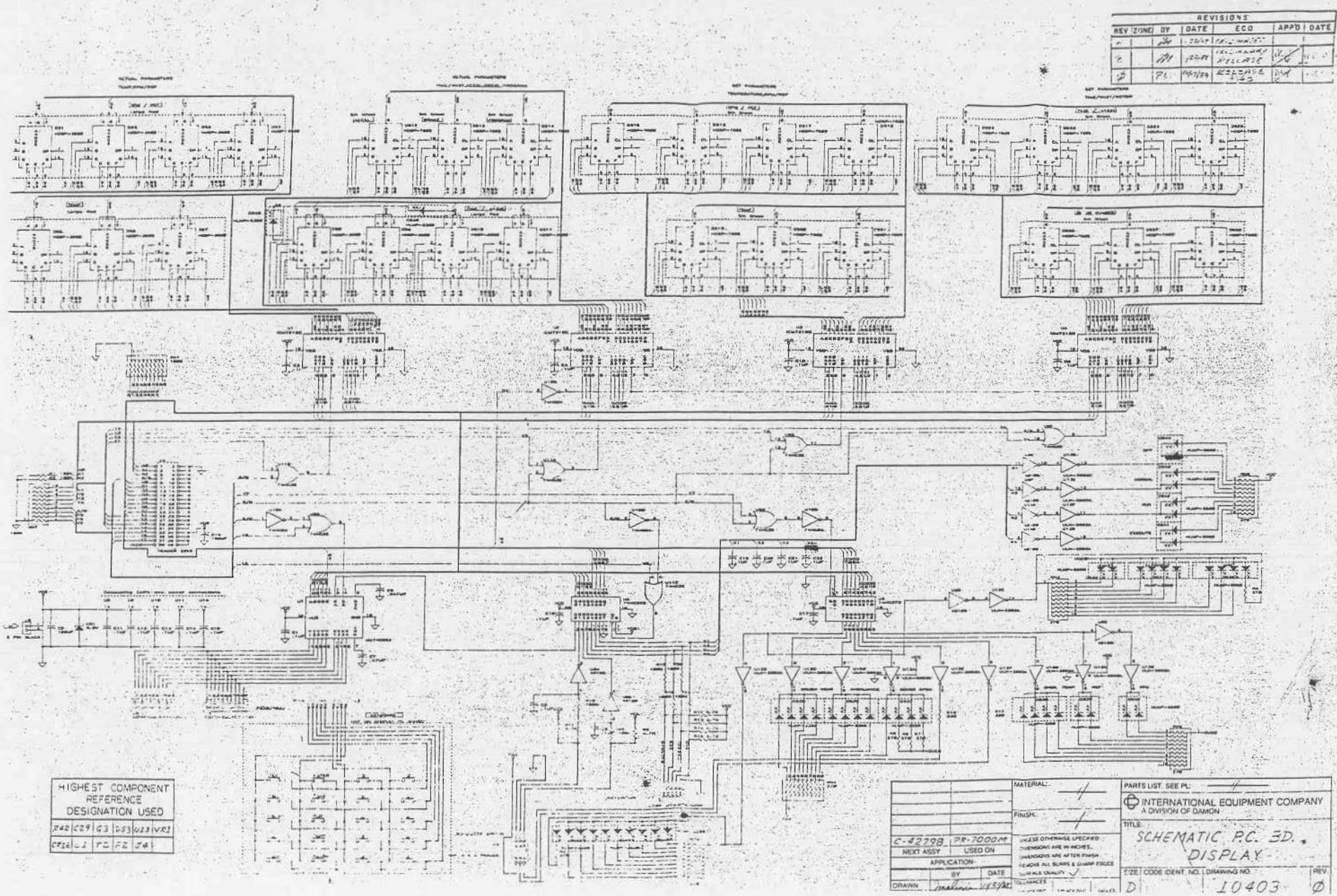
ASSY P.C. BD. PR-7000M LOGIC B-45265
ASSY/MARKING P.C. BD. FILTER C-41970
ASSY/MARKING P.C. BD. POWER C-42797
ASSY P.C. BD. PR-7000M P&M B-45278
ASSY/MARKING P.C. BD. RELAY C-41969
WIRING HARNESS C-40480
WIRING HARNESS C-41312
WIRING HARNESS C-40570
WIRING HARNESS C-41396
WIRING HARNESS C-42014
WIRING HARNESS C-41896
WIRING HARNESS C-42686
WIRING HARNESS C-42687
CABLE ASSY C-41371
CABLE ASSY C-41772
CABLE ASSY C-41370
CABLE ASSY C-41369
INTL MODELS
240V AC IN
MOTOR
MOTOR FAN
LATCH SOLENOID
COMPRESSOR
COMPRESSOR FANS
THERMISTOR
OVERTEMP
LATCH
INTERLOCK
IMBALANCE
HALL CELL SENSOR
CHOKE
LINE FILTER
POWER SUPPLY
RUN RELAY
BRAKE RELAY
TRANSFORMER
CKT BRKR
MODE SWITCH
DOOR
STOP
START
BRUSH
PROGRAM
BRAKE
ACCEL
TIME
RATE
RPM
TEMP
ENTER
SPLICE-A
SPLICE-B
SPLICE-C
SPLICE-D

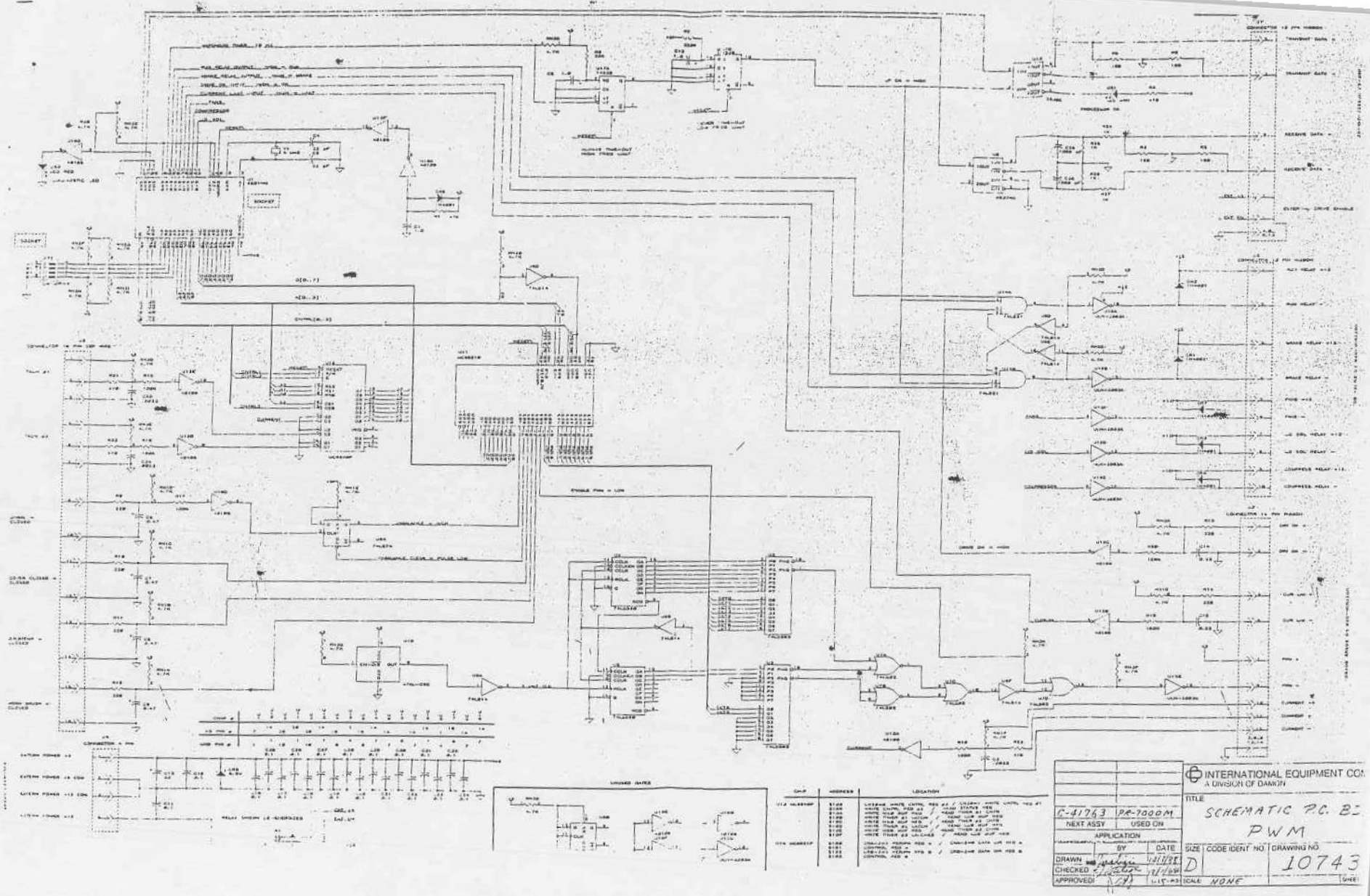

S3
MODE SELECT
KEY SWITCH
S2
S1
START
RT1
THERMISTOR
LOGIC
BOARD
DISPLAY
BOARD
TIME
PROG
BRAKE
RAD
ACCEL
TEMP
RPM
PAD
SWITCHES
ENTER
Z01
LINE
FILTER
F1
20 AMP
S.B.
RC1
BR1
RUN RELAY
AC
PWM
BOARD
POWER
BOARD
L2
CHOKE
B1
MOTOR
ARM
FLD
FILTER BOARD
K2
BRAKE
T1
AUTOTRANSFORMER
(REFER TO MANUAL
FOR CONNECTIONS)
240V
220V
200V
120V
100V
0V
INTL MODELS
CB1
CIRCUIT
BREAKER
240VAC
INPUT
(GRN/YEL)
GRN
WHT
(BLU)
RELAY
BOARD
B2
COMPRESSOR
B3/B4
COMPRESSOR
FANS
L1
LATCH
SOLENOID
Z02
LINE
FILTER
J/P25
(INPUT)
+5VDC
COM
+12VDC
PS1
DC POWER SUPPLY
HALL EFF
SENSOR (MOTOR)
S4
IMBALANCE
S5
INTERLOCK
S6
LATCH
S7
OVERTEMP
S8
BRUSH
INTERNATIONAL EQUIPMENT COMPANY
SCHEMATIC DIAGRAM
PR-7000M
10762



REVISIONS						
REV	ZONE	BY	DATE	ECO	APP'D	DATE
A		JH	12-4-79	RELEASE		
B		MM	12-5-79	RELEASE		
C		PL	1/9/79	RELEASE		

HIGHEST COMPONENT REFERENCE DESIGNATION USED					
Z42	C29	G3	D53	U23	VR1
CR16	J	FC	F2	J4	

		MATERIAL:	PARTS LIST. SEE PL:
		FINISH:	INTERNATIONAL EQUIPMENT COMPANY A DIVISION OF DAMON
C-42798	PR-7000M	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DIMENSIONS ARE AFTER FINISH REMOVE ALL BURRS & SHARP EDGES	TITLE: SCHEMATIC P.C. 3D. DISPLAY
NEXT ASSY	USED ON		
APPLICATION			
	BY / DATE		SIZE / CODE IDENT. NO. / DRAWING NO. / REV.
DRAWN			D / 10403 / Ø



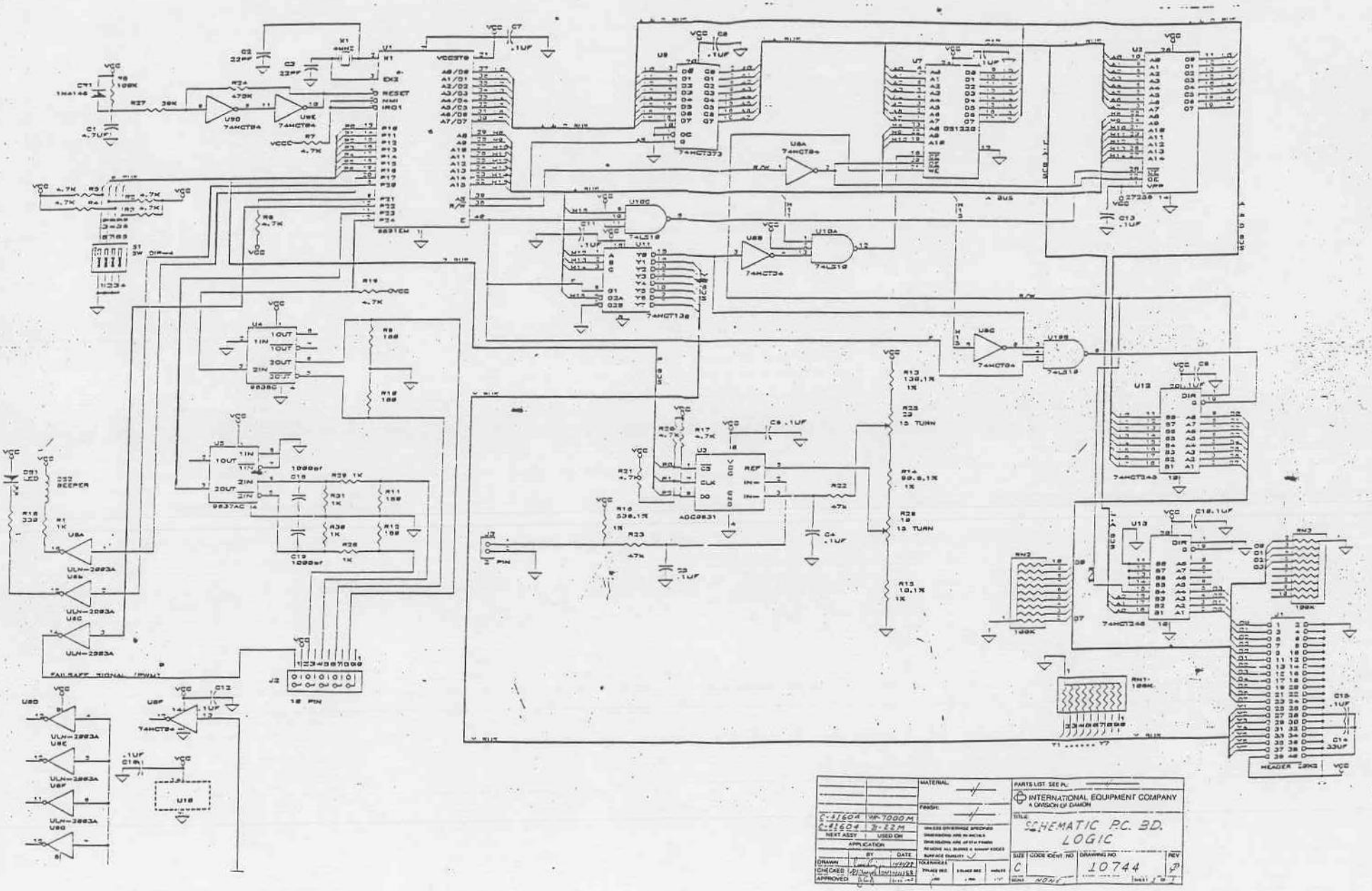
C-41743	PR-7000M		
NEXT ASSY	USED ON		
APPLICATION			
	BY	DATE	
DRAWN			
CHECKED			
APPROVED			

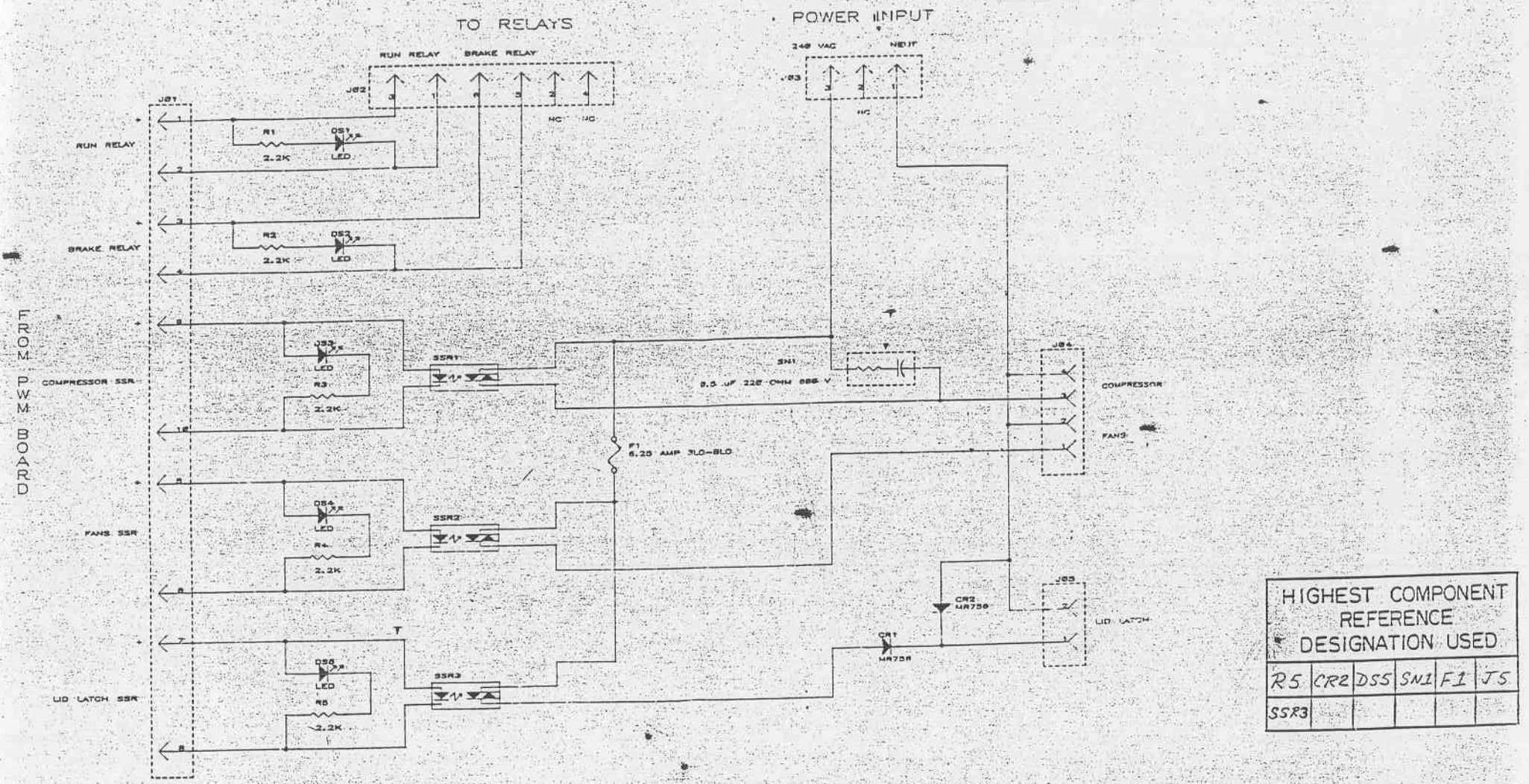
INTERNATIONAL EQUIPMENT CO.
A DIVISION OF DAMON

TITLE: SCHEMATIC P.C. B.
PWM

SIZE	CODE IDENT NO	DRAWING NO
D		10743

SCALE: NONE


INTERNATIONAL EQUIPMENT COMPANY
A DIVISION OF DAMON
SCHEMATIC PC. BD.
LOGIC
10744
74HCT04
74HCT373
74HCT138
74HCT245
74HCT86
74HCT244
74LS19
ULN-2803A
ADC0831
27256
FAILSAFE SIGNAL (PWM)
12 PIN
HEADER 20X2



HIGHEST COMPONENT REFERENCE DESIGNATION USED					
R5	CR2	DS5	SN1	F1	J5
SSR3					

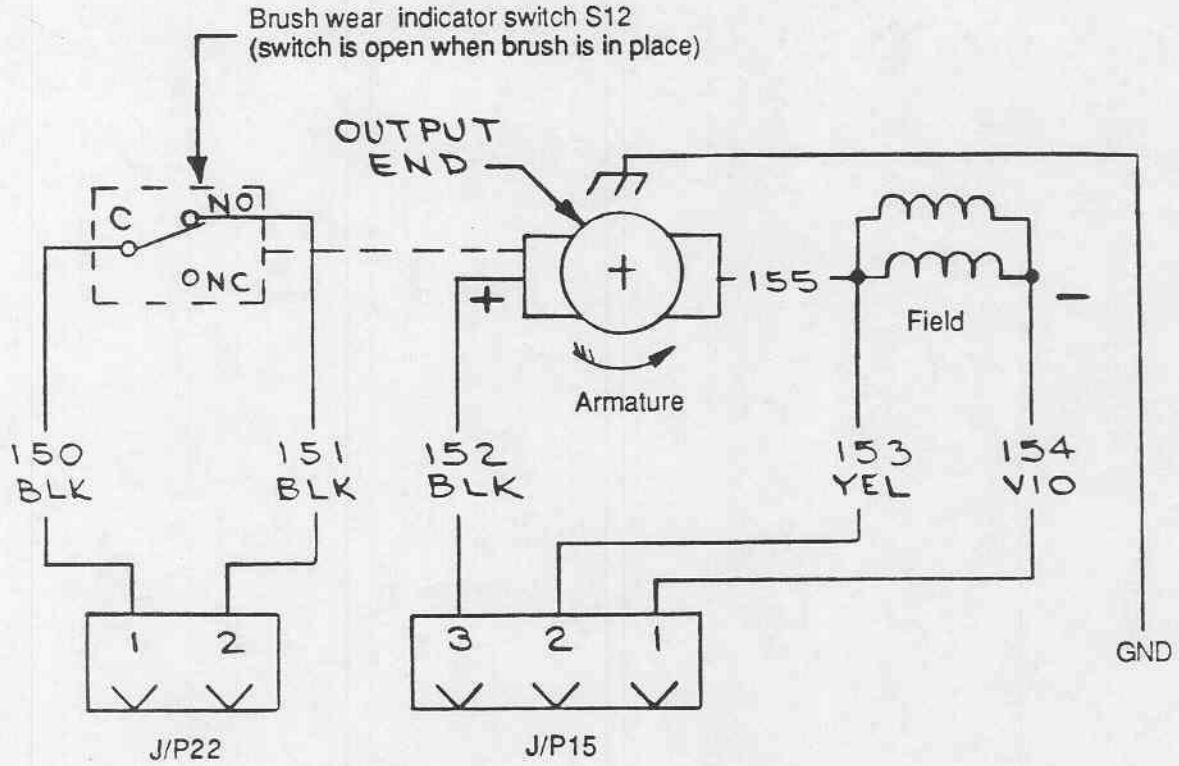
		MATERIAL:	11
		FINISH:	11
C-41969	PR-7000M	UNLESS OTHERWISE SPECIFIED:	
NEXT ASSY	USED ON	DIMENSIONS ARE IN INCHES.	
APPLICATION		DIMENSIONS ARE AFTER FINISH.	
	BY / DATE	REMOVE ALL BURRS & SHARP EDGES.	
DRAWN	11/23/98	SURFACE QUALITY ✓	
		TOLERANCES	

PARTS LIST. SEE PL: 11

INTERNATIONAL EQUIPMENT COMPANY
A DIVISION OF DAMON

TITLE: SCHEMATIC P.C. BD. RELAYS

SIZE	CODE IDENT. NO.	DRAWING NO.	REV.
C		10759	Ø



J/P15 Nominal Resistance	
Pin 1 to 3	2.0 ohms
Pin 1 to 2	0 .43 ohms

Figure 4-9 Motor B1 Wiring Diagram

4.11 Parts Assembly

The following illustrations show most assembly parts and how they fit into the centrifuge.

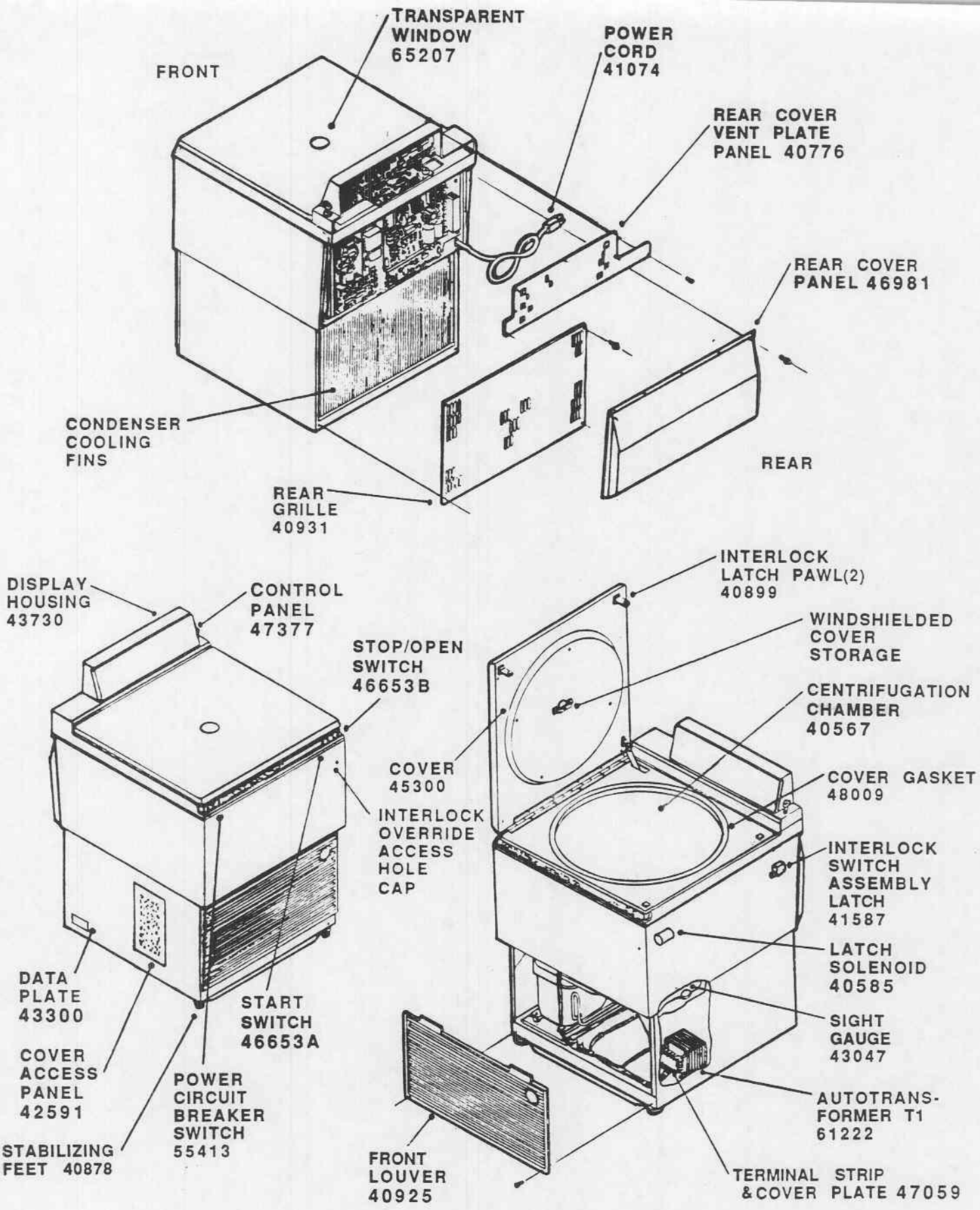


Figure 4-10 PR-7000M Centrifuge (I of 2)

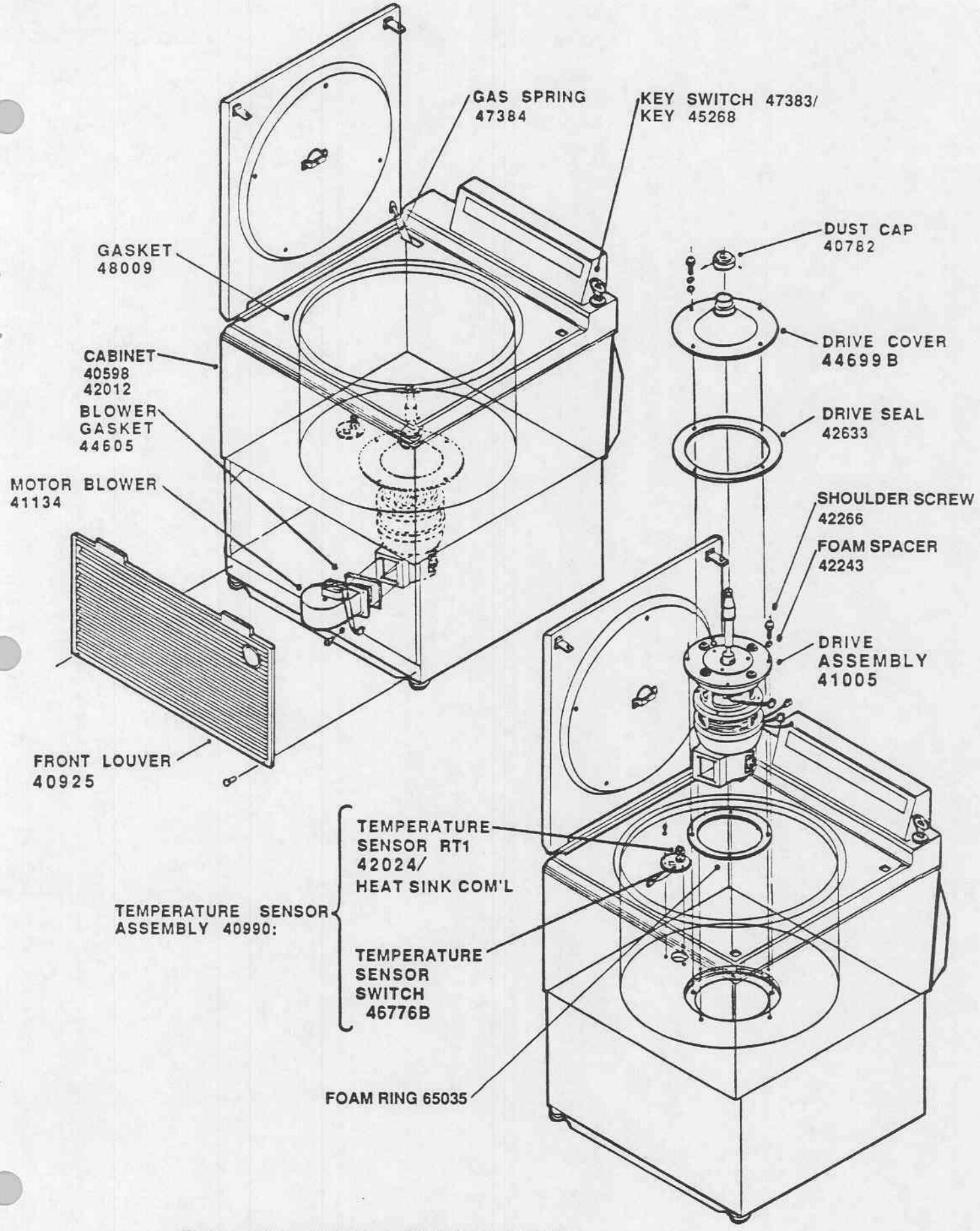


Figure 4-10 PR-7000M Centrifuge (2 of 2)

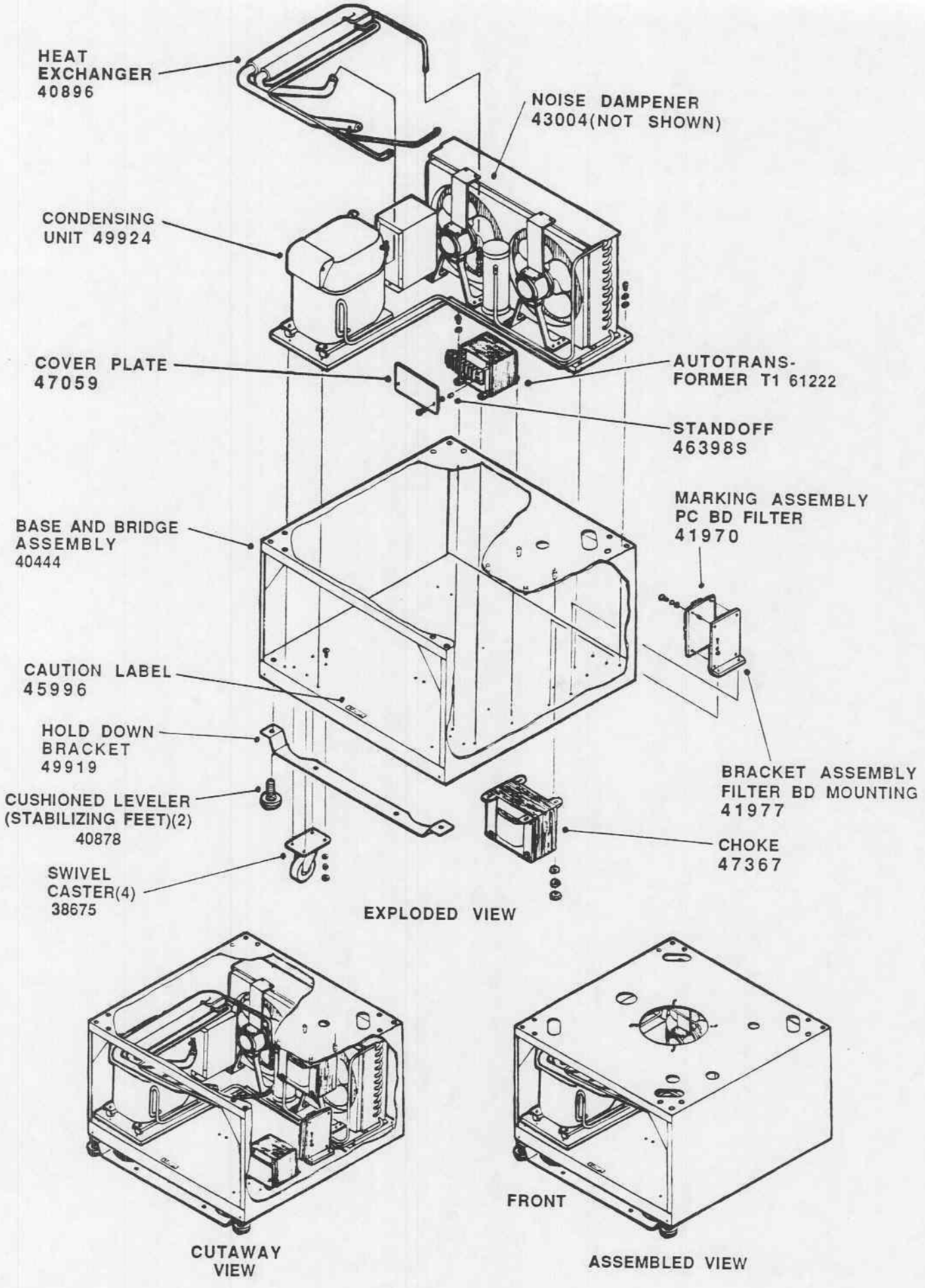


Figure 4-11 Base Assembly

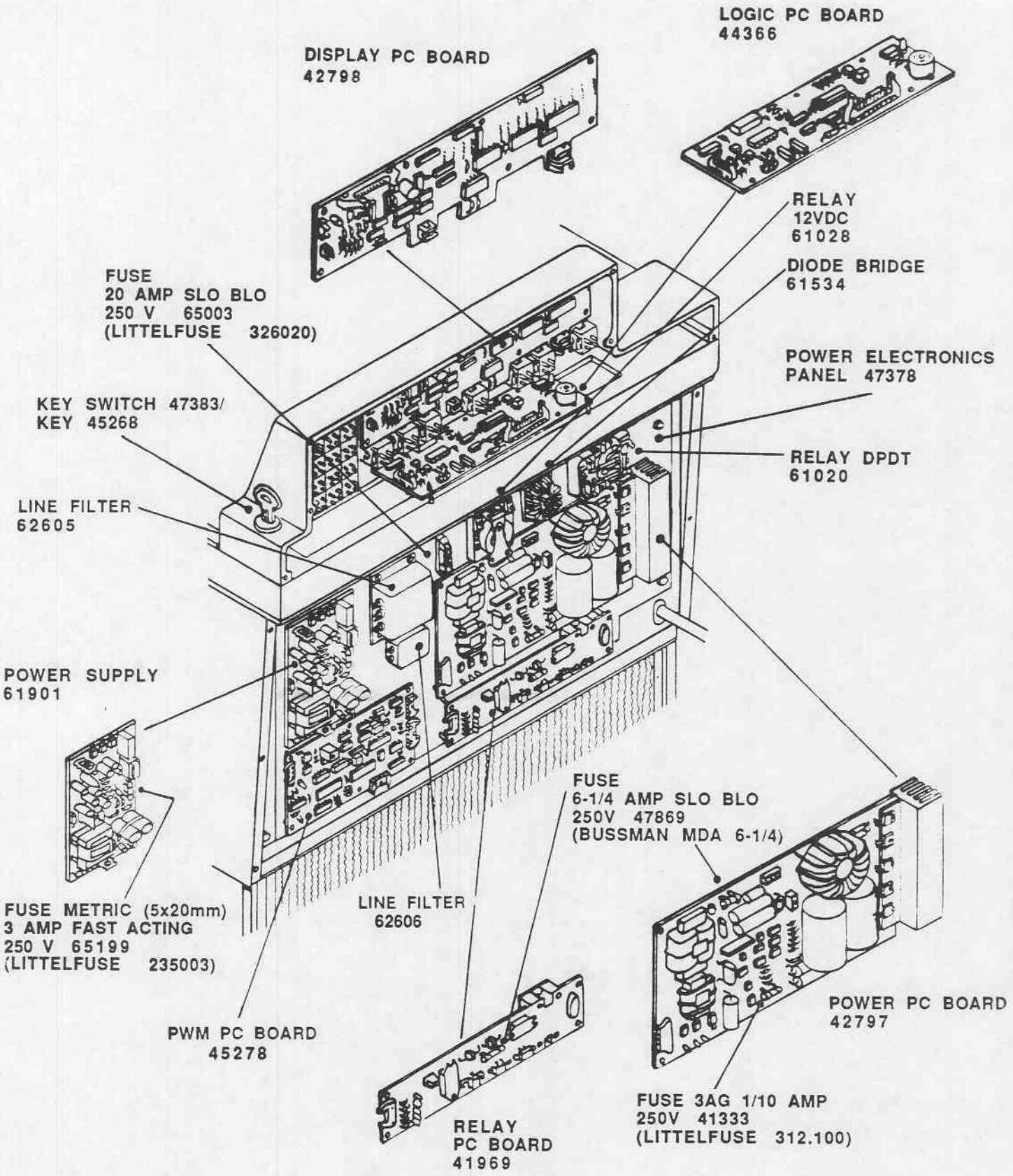


Figure 4-12 Rear Electrical/Electronic Components

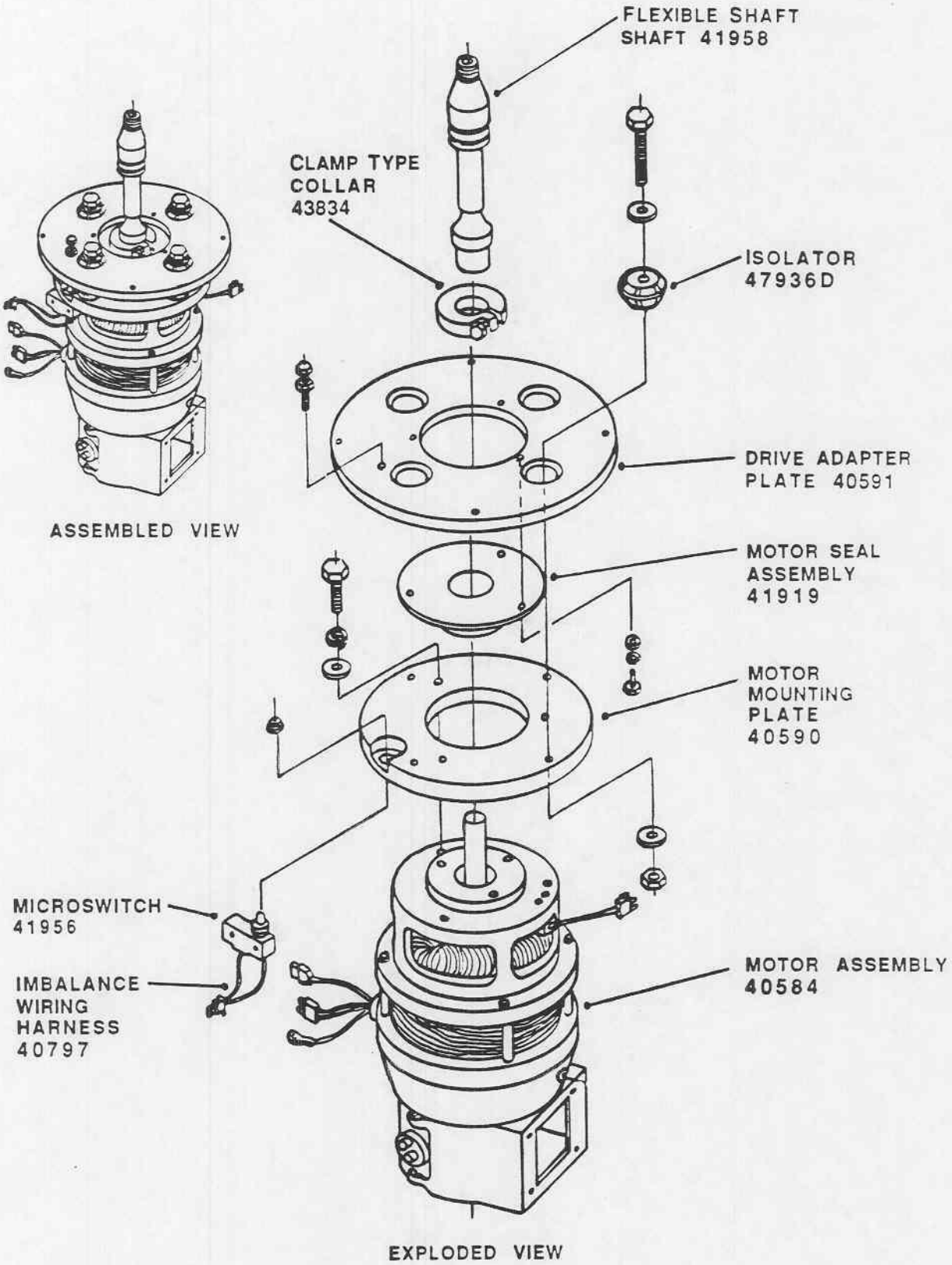


Figure 4-13 Drive Assembly 41005

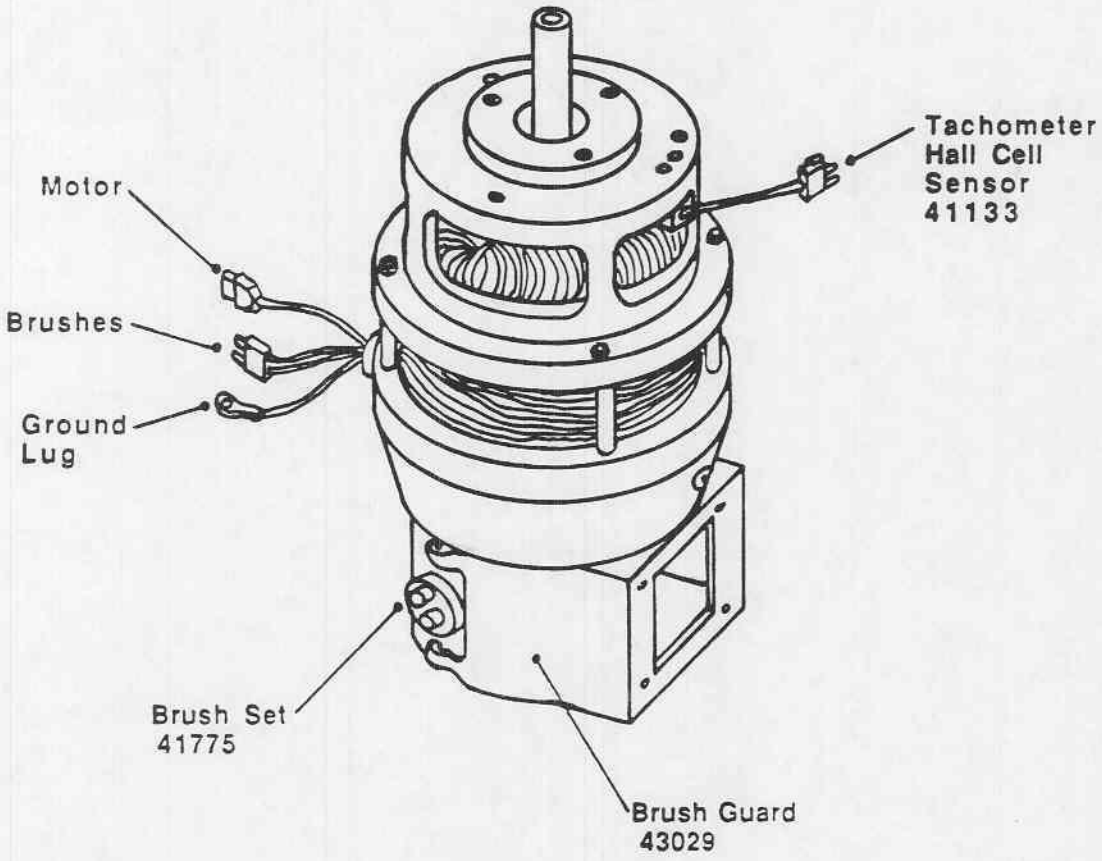


Figure 4-14 Motor Assembly 40584